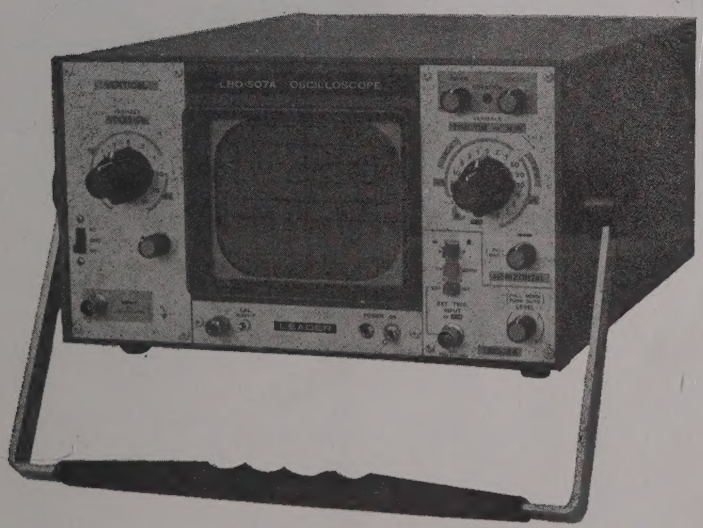
LEADER TEST INSTRUMENTS

MODEL LBO-507A

5″ OSCILLOSCOPE

OPERATING INSTRUCTIONS
AND SERIVCE MANUAL



LEADER ELECTRONICS CORP.

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1. INTRODUCTION

This LBO-507A is a single trace osilloscope with bandwidth of DC–20 MHz and sensitivity of 10 mV/cm. With the adoption of highly bright CRT, bright, clear, and large display is to be obtained.
This instrument equipped with wide bandwidth for checking TV and VTR is suitable for use in school because of its portability and is also elaborately designed for easy and convenient operation.

- Wide bandwidth and high sensitivity
  In addition to wide bandwidth from DC–20 MHz (–3dB, 4cm), this instrument provide high sensitivity of 10 mV/cm. 30 MHz frequency is to be obtained with the improved triggered synchronization.
- New and Highly Bright C.R.T.
  With the adoption of new, highly bright CRT, bright and clear display can be obtained. Stable accelerated high voltage to CRT and Calibration accuracy of voltage and Time Base are provided.
- TV Synchronization
  Circuit for extracting the synchronizing signal is equipped to synchronize easily with composite video signal. Synchronizing pulse of TV-Vert. and TV-Horiz. is automatically selected by Time Base Switch.
- Improvement in portability and operation.
  Equipped with a big, carrying-handle, and yet, designed for lightness, this unit is excellent both in portability and in operation with many functions installed on the front panel.

2. SPECIFICATION

CRT Display	
Type	130BXB31 or C5S66P31
Acceleration Voltage	2000V
Effective display area	8 × 10 cm
Intensity Modulation:	Blanked by TTL level signal.
Vertical amplifier	
Sensitivity:	10mV/cm – 20V/cm calibrated in 11 steps (1-2-5 sequence up to 50V/cm with variable control)
Accuracy	±3%
Bandwidth	(DC) DC-20MHz (–3dB, 4 cm deflection) (AC) 2Hz-20MHz (–3dB, 4 cm deflection)
Rise time	17.5 n Sec.
Input impedance	1 MΩ shunted by 35pF ±5pF
Input coupling	AC,DC, GND
Max. input voltage	600 V (DC + AC p-p)
Input connector	BNC
Time base	
Sweep speed	0.5 μS/cm –200mS/cm, 18 step, 1-2-5 sequence up to 500mS/cm with variable control.
Accuracy	±5%
Magnification	X5 ±5% (max speed 100nS/cm)
Synchronization	
Mode	Normal trigger and Automatic trigger. On automatic synchronization, in some cases, no signal is provided. Trace can be seen with synchronization level off very little to with time base range.

Signal source	Internal or external, + or – slope

TV Synchronization

Extracts the synchronizing signal from composite video signal and provides stable synchronization. Slope switch is selected according to polarity of video signals.

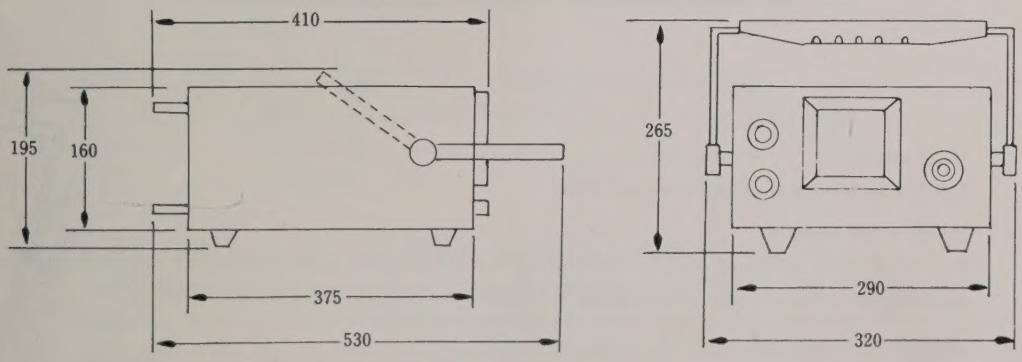
Sensitivity	Triggered (INT.) 2Hz – 20MHz at 1 cm
	(EXT.) 2Hz – 20MHz at 150mVp-p
	Automatic (INT.) 50Hz – 20MHz at 1 cm
	(EXT.) 50Hz – 20MHz at 150mVp-p

Horizontal amplifier

Sensitivity	200m V/cm (MAG. X5)
	1V/cm (MAG. X1)
	Up to 5V/cm with fine adjuster
Bandwidth	DC–250 KHz (–3dB, 10 cm deflection)
Input impedance	100 kΩ shunted by 35pF
Input connector	BNC

Calibration

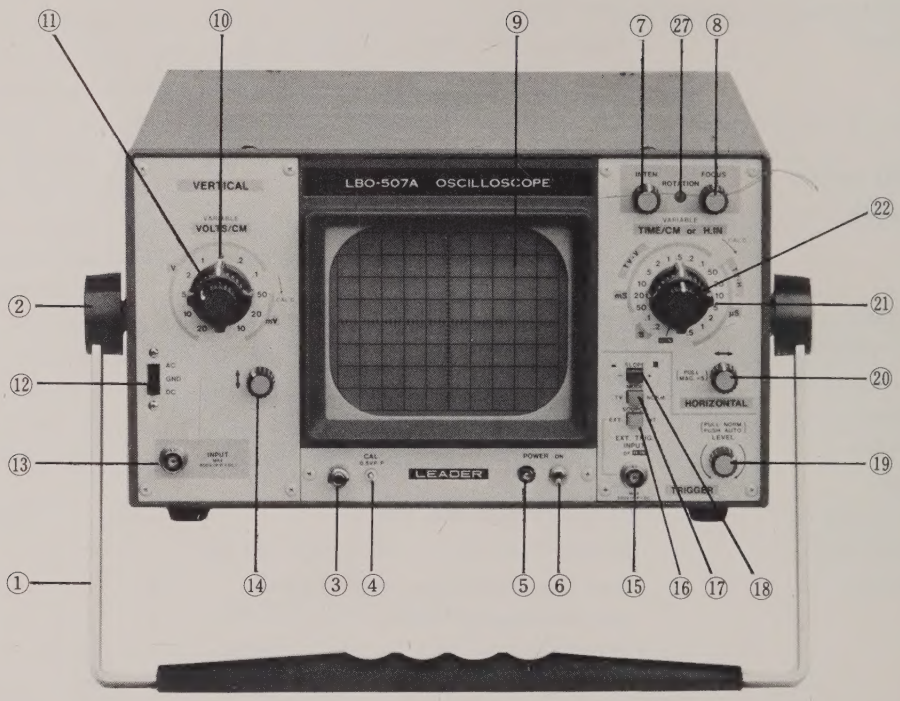
Wave form	Square wave at line frequency
Voltage	0.5 Vp-p ±3%
Power supply	117/230V: 50/60Hz, 33W
Size and weight	160(H) X 290(W) X 375(D) mm 6.5 kg
Accessories	Low capacitance/Direct probe LP-16X 1
	Terminal adapter. 1
	Slow blow fuse 1



3. DESCRIPTION OF PANEL FUNCTIONS

The numbers enclosed with circles in this instruction manual refers to the control knobs and function switches of the LBO-507.

3-1 Front Panel

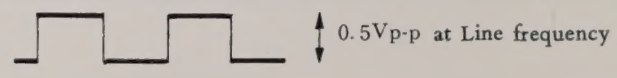


① Hand carrier
The hand carrier can also be used as a stand.

② Hand carrier stopper
Locks the hand carrier at 22.5°. Firmly press in each stopper with both hands, the hand carrier will be unlocked and rotate freely. Upon release the hand carrier will revert to locked position.

③ Ground terminal

④ CAL 0.5Vp-p (Calibration wave)
Signal output terminal for amplitude and probe calibration.



⑤ PILOT LAMP
The lamp lights when the power is on.

⑥ POWER ON
Turns the power on or off.

⑦ INTEN

Adjusts pattern luminance or brightness on the screen. With the knob turned clockwise, the pattern luminance or brightness increases, with the knob turned counterclockwise, the luminance or brightness decreases.

⑧ FOCUS

Adjusts focus grid voltage for clarity of the display.

⑨ Graticule

A size of graticule is 8 by 10 cm. Sub-scales of 2 mm interval are imprinted on the graticule in the form of Cross for easy reading.

Vertical Voltage sensitivity (Volt/cm) and Sweep time (TIME/cm) is adjusted and can be read with reference to this sub-scales.

⑩ VOLTS/cm black knob.

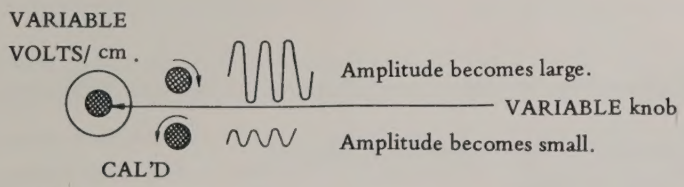
This is a knob for switching the sensitivity of the input signal fed to ⑬. Switching action is accomplished in 11 steps from 10mV/cm to 20V/cm.

When measurement is made by the use of the indicated voltage sensitivity, be sure to set the VARIABLE ⑪ (red knob) to CAL'D by turning it fully clockwise until it clicks. Also, when the signal is applied to the input terminal ⑬ by the use of a 1/10 low capacitance probe, the values are ten times the indicated voltage.

⑪ VARIABLE (sensitivity fine adjuster), red knob

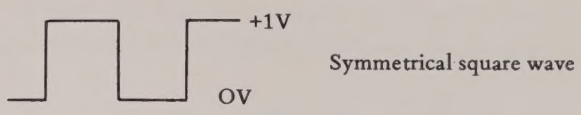
This is a vertical axis sensitivity fine adjuster which is capable of attenuating to less than 1/2.5 the indication of each range of VOLTS/cm.

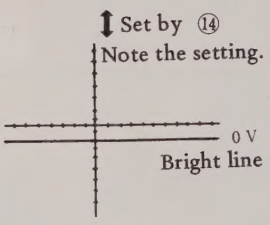
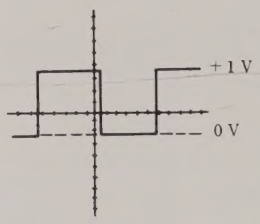
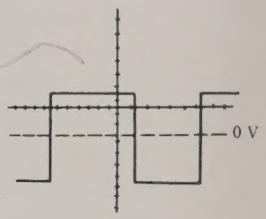
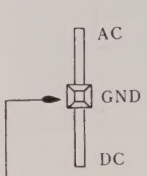
To measure a voltage by the use of voltage sensitivity indicated by VOLTS/cm, turn the VARIABLE clockwise to the full, to ↷ CAL'D until it clicks.

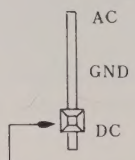


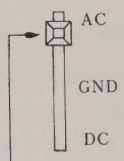
⑫ AC-DC-GND (Alternating Current-Direct Current-Ground Switch)

Switches the coupling of the signal fed to the vertical axis input ⑬. DC coupling is obtained on the DC position, on AC position the direct current component is blocked by a capacitor. The GND position grounds the input of the amplifiers and opens the input terminal ⑬. The following table illustrates a display at each switching position (AC-DC-GND).

<table>
<tr><td>Input signal</td><td colspan="3"> 

Symmetrical square wave</td></tr>
<tr><td>Wave form and its position on the screen</td><td> 
</td><td> 
</td><td> 
</td></tr>
<tr><td>Position of switch ⑫</td><td> 

Zero position (OV)</td><td> 

DC content can be measured</td><td> 

Only change in AC content can be measured.</td></tr>
</table>

⑬ INPUT

Input signal connection. Note the maximum input voltage condition. 600V (p-p +DC).

⑭ ↕

This knob positions the beam in the vertical direction.

⑮ Ext. TRIG or Ext. H INPUT

For connection to external horizontal input or external triggering signal source.

⑯ ▮SOURCE▬, INT./EXT.

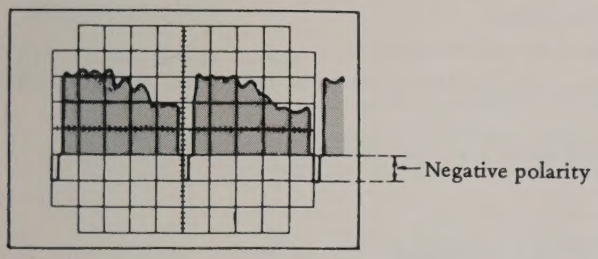
Selects intereal synchronizing signal source at INT. position. Normal operation is performed with this switch at the INT. position. EXT. position is used when synchronization is desired when another signal synchronized with the signal fed into the vertical input is applied to the EXT. TRIG' INPUT terminal ⑮.

⑰ ▮ MODE ▬

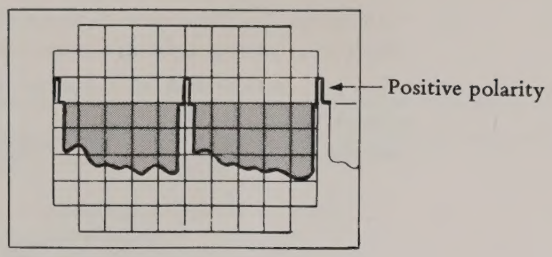
TV (Video signal)/NORM

Extracts the synchronizing signal from composite T.V. or V.T.R. signals (vedeo signals) and provides synchronization with the T.V. vertical synchronizing signal when the sweep time ㉑ is in the range of 0.5ms/cm ~ 0.2s/cm and with the horizontal synchronizing signal in the range of 0.2ms/cm ~ 0.5μs/cm. At this point, it is necessary to select the SLOPE ⑱ at illustrated below in accordance with the polarity of the video signals.

Synchronizing pulse polarity video signals and selection of SLOPE.



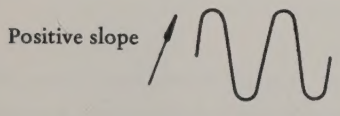
SLOPE −



SLOPE +

⑱ ▮ SLOPE: ▁ +/−

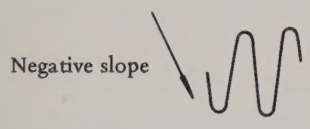
If triggered sweep is desired against the positive slope of waveforms displayed on the screen, set this switch to (+) position, and against negative slope, set it to (−) position, whichever is applicable.



SLOPE

▮ +

(Push-out)



SLOPE

▁ −

(Push-in)

⑲ LEVEL

The control knob is used to adjust the triggering level of the sweep. At the "out" (PULL) setting, the sweep will be in the normal condition, i.e., triggered with the input waveform. At the "in" (PUSH) setting, the sweep will be automatically synchronized with the input waveform provided the frequency is above 50Hz. However, at no input, or at low triggering levels when there is no control, only the horizontal trace will be displayed. In operation, the knob is generally at the in. or AUTO, setting.

⑳ (PULL / MAG ×5) ⟷

The knob is used to position the trace in the horizontal direction. When the knob is pulled out, the sweep is magnified by a factor of 5.

㉑ TIME/cm (Time-change switch)

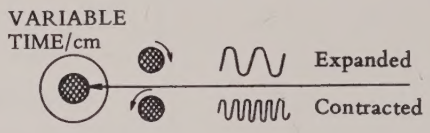
This is Sweep Time-Change switch. This can be changed between 0.5 μS/cm ~ 0.2 S/cm in accordance with the requirements. If it is switched on [H IN] position, interval sweep circuit stops and input terminal of ⑮ connects with H AMP. Horizontal Line is to be operated by external signal. At the same time MAG of ⑳ operate. On [H IN] fine adjustment of sensitivity is done by variable knob of ㉒.

㉒ VARIABLE (fine adjustment of Sweep Time) Red Knob

This is a fine adjuster covering the time uncovered by time change-steps.

When you measure with an indication of time, turn VARIABLE clochwise to the full, that is, to CAL'D where it clicks.

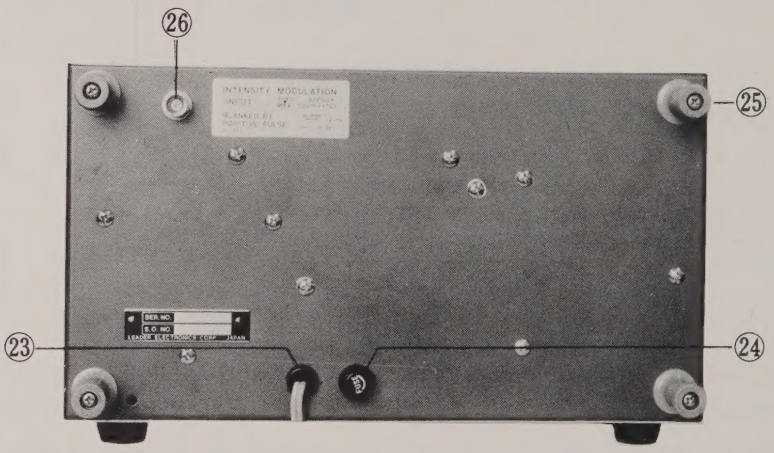
And also, in the position of [H IN], VARIABLE works as an fine adjuster of horizontal sensitivity.



㉗ ⊘ ROTATION

The effect of the earth's magnetic field may cause slight tilting of the horizontal traces due to placement of the instrument. Move the traces to the center of the scales on the screen, adjust the ROTATION knob with a screw driver in the direction that cause the traces to become parallel with the horizontal scales.

3-2 Rear Panel



㉓ Power Supply Cord

Pay attention to the stipulated voltage

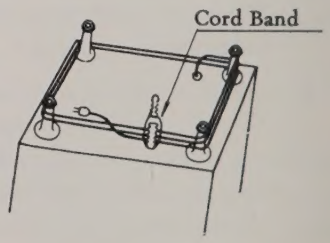
㉔ Fuse

Turning the knob counterclockwise cap and fuse will come off together. Pay attention to the kinds and rates of fuse. (refer to 4-1, page 8)

㉕ Legs for vertical viewing and AC cord winding

These are legs for vertical viewing and AC cord winding convenience.

To store or shorten AC cord wind around legs.



㉖ Intensity Modulation Terminal

Intensity modutation can be obtained when the voltage of 0 ~ +5V is applied. The bright line will be blanked by a positive pulse about +2 ~ +5V.

Cautions should be taken not exceed maximum allowed input voltage, 50V (p-p + DC) and input impedance, 10kΩ.

4. PRECAUTIONS

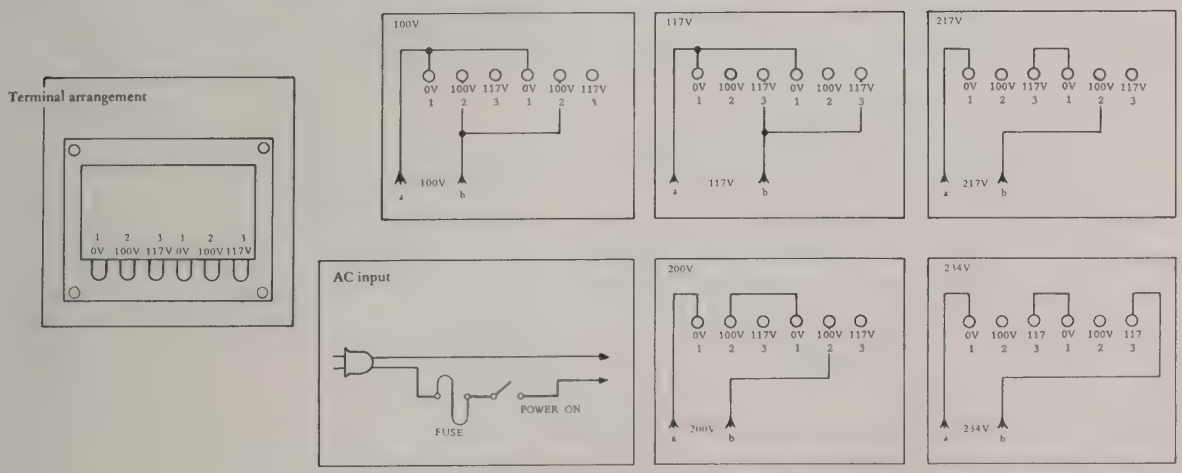
4-1 Power Source Voltage

Apply a power source voltage that is within ± 10% of the rated values as given in the table below. Operation with a voltage less than 10% of rated value may result in improper performance of the LBO-507, and a voltage more than 10% of rated value may damage power supply circuitry.

Rated Voltage Values	Applicable Voltate Ranges	Fuse
100V 117V	90 – 110V 105 – 129V	0.5A, 60℃ Slow Blow
200V 217V 234V	180 – 220V 195 – 239V 211 – 257V	0.25A, 60℃ Slow Blow

The built-in power transformer has taps of 100, 117, 200, 217, 234V. To make the instrument suitable for a local line voltage, rearrange the wiring of the transformer in accordance with the examples depicted below. The rating of the fuse used must be as shown in the above table.

Terminal Arrangement and Wiring Diagram of the Power Transformer



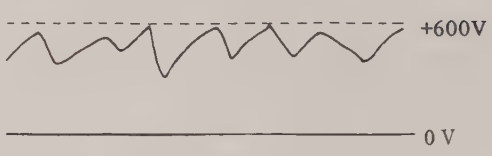
4-2 Signal Input

A voltage higher than 600V (ACp-p+DC) applied to the VERT. Input, or the low capacitance probe may damage circuit components.

Vertical input terminal	INPUT ⑬	MAX 600V (ACp-p + DC)
External synchronizing signal or H input terminal	TRIG. or H IN ⑮	MAX 100V (ACp-p +DC)

Probe input (LP-16) MAX 600V (ACp-p +DC)

The value of 600V (ACp-p + DC) is shown in the following figure.



4-3 **Horizontal Trace Tilt**

Horizontal Trace, in some cases, tilts with the affection due to the earth magnetism. In such cases change the location of the Unit or rotate the CRT for aligning trace-tilt

Input terminal of Vertical axis and CAL terminal of ④ is to be connected by the provided probe. About more details regarding use of probe. Please refer to the use of low capacitance/direct probe of 5-3.

4-4 **Operation in a Powerful Magnetic Field**

Operation in a powerful magnetic field will cause distortion of waveforms or make traces tilt excessively. Special care should be exercised when operating the instrument close to machinery or equipment using a large transformer.

4-5 **Operation in a Hot and Humid Place**

This instrument is designed to operate in a temperature range of 0°C to +40°C and humidity range of 10 to 90%. Operation in severe environment may shorten the life of the instrument.

4-6 **Intensity**

A burn-resisting fluorescent material is used in the cathodes ray tube. If the cathode ray tube is left with a bright dot or bright line, or with unnecessarily raised intensity, its fluorescent screen may be damaged. When observing waveforms, therefore, the intensity should be maintained at the minimum necessary level. If the instrument is left on for extended periods, lower the intensity and obscure the focus.

5. Fundamental Operation Instructions

The fundamental operation for observing waveforms with the Oscilloscope LBO-507 are described below.

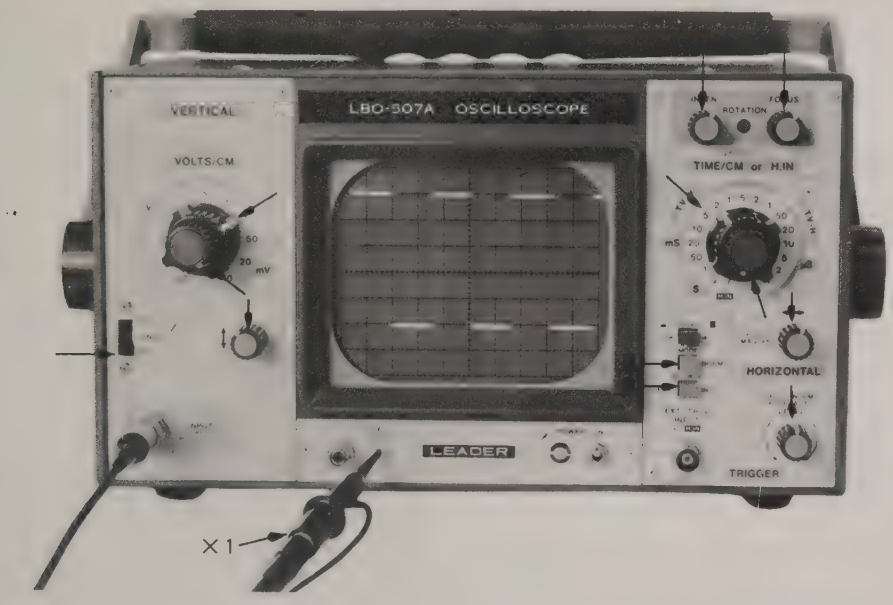
5-1 **Preparation**

Before using the LBO-507, set the controls and switches as follows.

In addition, use these settings when checking proper operation of the instrument.

1.	INTEN ⑦	Midposition
2.	FOCUS ⑧	Midposition
3.	⑭	Midposition
4.	VOLTS/cm ⑩	0.1
5.	VARIABLE ⑪	Turn fully clockwise to) CAL'D
6.	AC-DC-GND ⑫	DC
7.	⑳	Midposition
	(PULL MAG X5)	PUSH-IN X 1
8.	VARIABLE ㉒	Turn fully clockwise to) CAL'D
9.	TIME/cm. ㉑	5mS/cm.
10.	SLOPE +/− ⑱	+ (arbitrary)
11.	MODE TV/NORM ⑰	NORM (Push-out)
12.	SOURCE EXT./INT. ⑯	INT. (Push-out)
13.	LEVEL ⑲ (PULL NORM / PUSH AUTO)	Push-in AUTO

After all settings are made, set the POWER switch ⑥ at ON. After about 30 seconds, one trace will appear on the screen. Adjust the INTENSITY ⑦ and FOCUS ⑧ controls for a clear display of the traces.



Input terminal of Vertical axis and CAL terminal of ④ is to be connected by the provided probe. About more details regarding use of probe. Please refer to the use of Low capacitance/Direct probe of 5-3.

5-2 Check of Gain by Calibrated Waves

After all settings are made as shown in Section 5-1, (Refer to "Front Panel Diagram.") as certain that a square wave with an amplitude of 5 cm is displayed on the screen.

This indicates that the instrument is operating properly.

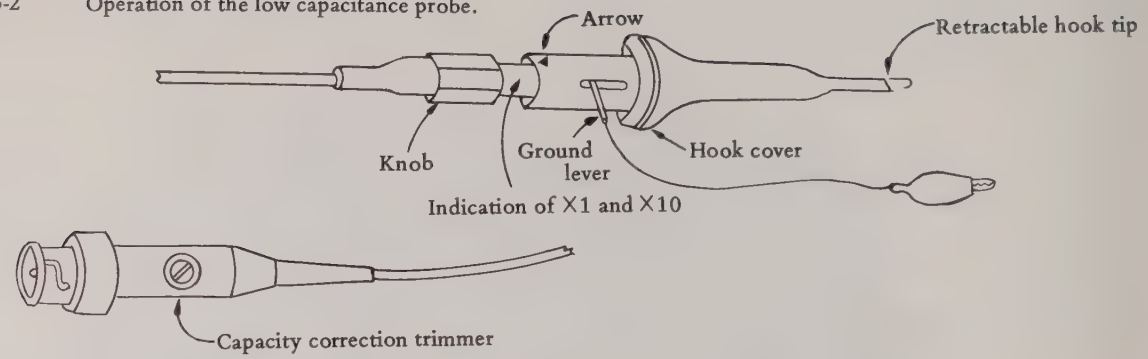
5-3 How To Use a Low-Capacitance/Direct Probe

The LP-16X Probe is an extremely well designed, high-performance probe equipped with ×1 and ×10 switching functions.

5-3-1 Specifications

Maximum input voltage	250Vrms or 600V DC
1-1 At ×10	
Input resistance	10MΩ (connected to oscilloscope of 1MΩ in input resistance)
Input capacitance	25pF or less
Correction range:	Oscilloscope with input capacitance 20 – 40pF
Attenuation factor:	1/10 ±2%
Frequency range:	DC – 40MHz
1-2 At ×1	
Input resistance:	1MΩ (connected to oscilloscope of 1MΩ in input resistance).
Input capacitance	250pF or less (connected to oscilloscope of 50pF or less)
Frequency range:	DC – 5MHz

5-3-2 Operation of the low capacitance probe.



Turn the knob and hook cover to the required position to set the arrow to X1 or X10.

The knob and hook cover may be turned in any direction, but care must be used not to disconnect the ground cover that holds the hook cover in place by an internal spring, which could loosen or break and disappear.

2-1 Measurement at X10

The probe exhibits high resistance and low capacity at X10. However, the input voltage is attenuated to 1/10, and, therefore, this must be accounted for in voltage measurement.

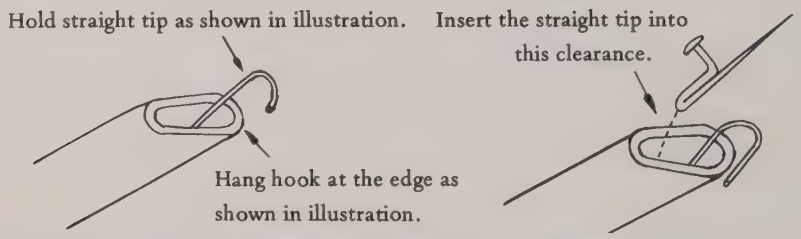
Measured voltage = Sensitivity of oscilloscope V/cm. X screen amplitude cm X 10

At X10, it is necessary to correct the pulse characteristic by adjusting the capacitor in the probe for flat top of the square wave calibration voltage (See 5-3-3).

2-2 Measurement at X1

This probe maintains high sensitivity in the X1 position so that it may be used directly with the oscilloscope. However, the input capacity is large approx. 250pF, and it is necessary to take this into account when making measurements.

2-3 How to insert the straight tip in probe.

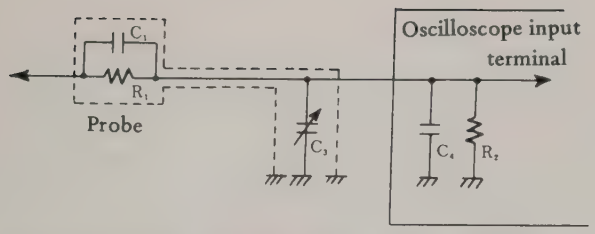

Hold straight tip as shown in illustration.
Insert the straight tip into this clearance.
Hang hook at the edge as shown in illustration.

The straight tip is extremely convenient when testing points on printed circuit boards.

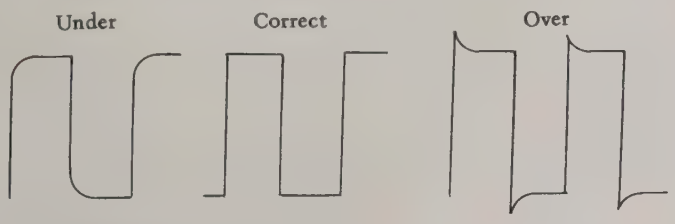
5-3-3 Adjustment of Probe

When observing the signal waveforms of high impedance circuit, the operation of the signal source and waveforms on the screen are liable to change due to the input impedance of the oscilloscope, parallel capacitance of a coupling line, induction noise and other effects, leading to measurement error. The use of a low capacitance probe avoids these effects. A low capacitance probe of 10:1 attenuation type such as the LP-16X or LP-8X should be used for high impedance circuitry measurements. Its input impedance is 10MΩ at 25pF. The basic construction of this probe is as shown below. Proper compensation may be obtained if the circuit constant is adjusted in such a way that the following equation will hold:

$R_1 \times C_1 = R_2 \times C_2, (C_2 = C_3 + C_4)$



To adjust the probe, connect as shown below and turn the variable capacitor (C_3) in the probe connector using a small screw driver, to provide proper square wave compensation.



5-4 Precautions on Direct Connection and Using a Probe

Two different methods are available for applying signals. One is to connect a lead wire or the like to the input terminal of the oscilloscope directly, and another is to use a probe.

When viewing a small signal in a circuit having high signal source impedance, error is liable to occur in measurement due to the effect of parallel capacitance or induced noise in the input cable. The following precautions should be observed to avoid false readings. Generally, with the exception of a low-impedance circuit, the use of a lead wire should be avoided as far as possible. That is, use X1 of the attached probe or a shielded wire such as coaxial cable. If a lead wire other than the probe or shielded wire is used, make the lead as short as possible. When using a shielded wire in a circuit having high impedance, attention should be paid to the loading effects of the sum of the input capacitance of the oscilloscope and the distributed capacitance of the probe or shielded wire on the signal source. The input terminal of the oscilloscope has a capacitance of about 35pF in parallel with 1MΩ. In addition, the direct probe has a distributed capacitance of about 250pF, and the coaxial shielded wire 60 to 70pF per meter. If the effect of this parallel capacitance on the high impedance signal source can not be ignored. The use of the low capacitance X 10 probe is recommended.

Low capacitance probe

To avoid many ill effects by direct connection use a low capacitance probe (X 10) as much as possible. When this probe is used, input impedance is 10MΩ, 25pF, thus making it possible to reduce the loading effects upon the signal source to a great extent. However, when the probe is used at X10, the input signal is attenuated to 1/10, this must be taken into account in all measurements.

5-5 Ground Connection

For ground connection, use the shortest possible wire as described in Section 5-4.

When using a probe, connect to a ground point close to the signal source, and use the probe ground wire.

5-6 Synchronization to Waveforms

The most important factor in operating the LBO-507 is to lock and display waveforms properly before measuring them with the oscilloscope.

To make the most use of the synchronizing capacitance of this instrument, a proper method of operation is described below, taking waveforms as an example. In addition, the following procedures describe how to obtain proper synchronization. For details, refer to 5-6-1 through 5-6-4.

1. Synchronizing Sweep	AUTO NORM	⑲ Push in the knob ⑲ Pull out the knob
2. Selection of Trigger Source	Interval Synchronization External Synchronization	⑯ ⑯
3. Coupling of Trigger Signal	NORM TV Signal	⑰ ⑰
4. Selection of synchronization position	Variable starting point Slope of Wareform	⑲ Variable adjustor ⑱ Selection of plus and minus

For simple waveform observation push in knob of ⑲ at Auto, push-out source of ⑯ at INT, push-out mode of ⑰ at Norm and put level knob of ⑲ at the white dotted center.

5-6-1 Mode of synchronizing sweep

The synchronizing sweep circuit of this instrument stops functioning if a trigger pulse is not produced as a sweep starting pulse. It is, therefore, necessary to select this sweep according to purpose desired.

Generally, for waveforms which have a frequency of 50Hz or more and are not complex, use AUTO synchronization. At AUTO synchronization, the sweep circuit is automatically placed in the free-run state when the aforementioned trigger pulse is not produced and a horizontal trace is displayed irrespective of sweep time set by the knob ㉑

To remove waveforms on the screen when no input signal is applied or the trigger level is not correct, depress switch ⑲ and set it to NORM.

5-6-2 Selection of synchronizing signal source

The operation called "synchronization" takes place to lock waveforms being observed. It is necessary to supply a synchronizing signal for this purpose to the oscilloscope. This instrument is capable of selecting either internal (INT) or external (EXT) sources of synchronization.

The SOURCE switch ⑯ is capable of supplying this synchronizing signal (source) from inside at INT and from outside at EXT.

INT Position

In normal observation of waveforms, the synchronizing signal is mostly supplied from inside by setting the switch at INT.

In the internal (INT) position a part of the vertical input signal which is amplified is extracted and supplied to the synchronizing sweep circuit as a synchronizing signal.

EXT Position

When observing composite signals or the like in which different types of signals in synchronous relationship are combined, the INT position permits stable synchronization, if each independent signal of the composite signal can be separated and used as a synchronizing signal. If not, this external (EXT) position permits supplying the required synchronizing signal to the synchronizing sweep circuit directly from outside. Set the SOURCE switch ⑯ at EXT, apply a synchronizing signal to the TRIG. IN terminal ⑮ . Since the level of the synchronizing signal is constant, stable synchronization can be obtained even if the level of the waveforms being observed varies.

5-6-3 Coupling of synchronizing signals

Even when the synchronizing signal is actuating the synchronizing sweep circuit, it is possible to have unstable synchronization of the waveforms being observed. This is due to an unwanted signal contained in the synchronizing signal.

It is also possible to have the synchronizing sweep circuit fail to operate even if the synchronizing signal is supplied. This occurs because insufficient synchronizing component to synchronize the waveforms being observed is contained in the signal.

Normal waveform observation

Set switch ⑰ at NORM. At this point, the synchronizing signal is connected to the synchronizing sweep circuit through a capacitor, thus eliminating the DC component and provides stable synchronization over the whole bandwidth of 2Hz or higher.

T.V. (Video) composite waveforms

In T.V. video waveforms, horizontal and vertical synchronizing components are combined. It is, therefore, very difficult to apply synchronization to the horizontal component or vertical component. In this case, set switch ⑰ at TV, and this will automatically select a horizontal synchronizing signal and vertical synchronizing signal and obtain stable synchronization. However, if the sweep time set by the switch ㉑ is 0.5ms/cm or less, the vertical synchronizing signal is selected. If it is 0.2ms/cm or more, the horizontal synchronizing is selected.

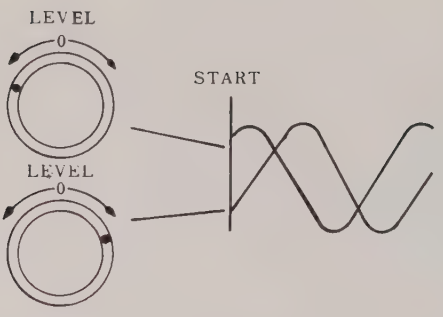
Position SLOPE switch ⑱ according to the polarity of the composite Video signals, as shown in the explanation of switch ⑰ , Section 3-1.

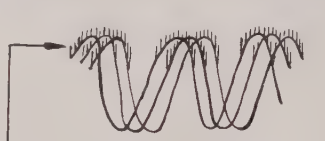
5-6-4 Selection of synchronization position

In a triggered sweep type oscilloscope, it is possible to adjust the position or timing of starting of the waveform so that stable trigger (starting) pulses may be obtained.

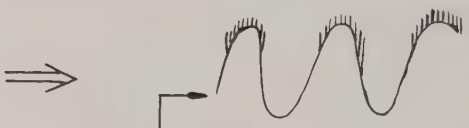
Adjustment of starting (trigger) position

To move the synchronization position to the section where changing waveforms are stable, adjust LEVEL knob ⑲ as shown below.





If noise is produced in the upper part of waveforms due to abnormal oscillation or the like, jittering may occur in the display.

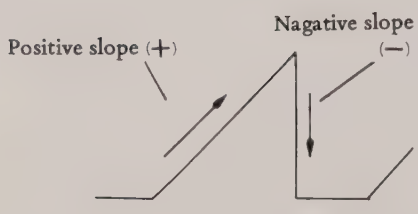


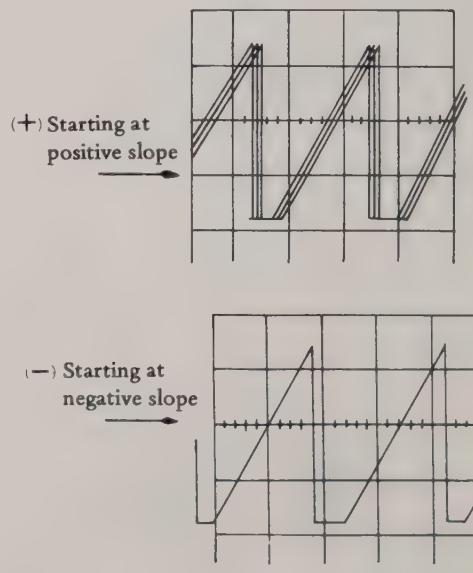
Adjust the LEVEL knob and move the starting point to the section having no noise, to provide stable display.

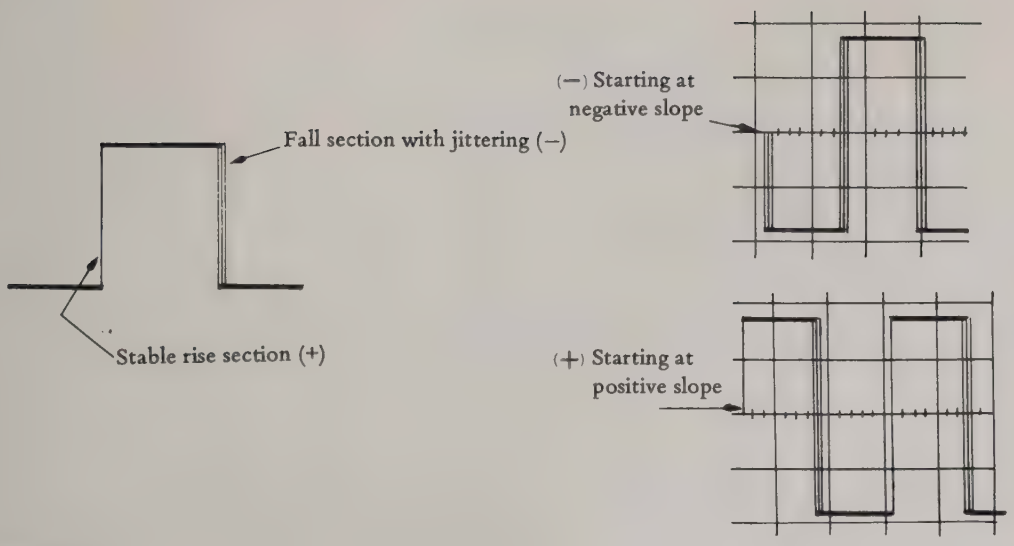
In the case of simple signals whose waveforms are not extremely symmetrical, set the switch at PRESET. Then, synchronization will take place almost in the center of the waveforms.

Selection of waveform slope (SLOPE +/−)

When the rise portion of the waveform is smooth and the fall section is steep, like a sawtooth wave, stable synchronization can be obtained if starting (trigger) is performed in the fall portion. Also, in case of a square wave, especially when jittering is taking place in the fall portion, stable synchronization can be obtained if starting is performed in the rise portion. SLOPE switch ⑱ functions to select the slope (rise or fall section) of the starting (trigger) point of this synchronizing signal waveform.







6. Measurements

6-1 AC Peak Voltage

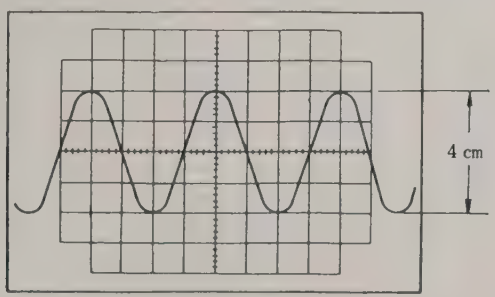
When it is desired to determine only the AC voltage component of the signal being measured, set AC-GND-DC switch ⑫ at AC. and , from the amplitude on the screen at this time, calculate the peak voltage as follows:

Measurement using a X 1 probe or lead wire

Peak voltage (Vp-p) = Value indicated at VOLTS/ cm . X amplitude (cm.)

Measurement using a X10 probe

Peak voltage(Vp-p) = Value indicated at VOLTS/ cm . X amplitude (cm .) X 10



As shown above, the voltage of the signal being measured is calculated as follows:

If VOLTS/ cm = 0.05V/ cm ,

Peak voltage when a X1 probe or lead wire is connected directly = 0.05V/ cm x4 cm . = 0.2Vp-p

Peak voltage when using a X10 probe = 0.05V/ cm X 4 cm X 10 = 2Vp-p

If the input waveform is a sine wave, the measured voltage (p-p) can be converted to effective voltage (rms). The following relationship exists between the peak voltage (Vp-p) and the effective voltage (Vrms).

$$\text{Effective voltage (Vrms)} = \frac{\text{Peak voltage (Vp-p)}}{2\sqrt{2}}$$

2Vp-p, for instance, is converted to rms value as follows:

$$\frac{2\ \text{Vp-p}}{2\sqrt{2}} = \frac{2}{2 \times 1.414} = 0.707\ \text{Vrms}$$

Notes
1. When switch ⑫ is set at "AC," the low frequency characteristic is attenuated to −3dB at 2Hz. Also, note that no AUTO synchronization is accomplished at 50Hz or less.
2. When measuring a voltage, be sure to turn the VARIABLE knobs ⑪ fully clockwise to CAL'D.

6-2 DC Voltage

Use AUTO sweep, set AC-DC-GND switch ⑫ at GND. The trace (bright line) should show OV. Set the trace to a position for easy measurement on the screen. Next, set the AC-DC-GND switch at DC and read the shift of the trace on the screen. Adjust the VOLTS/cm switch so that the trace will be displayed on the screen. An upward shift of the trace (bright line) represents (+) and a downward shift (−).

From the shift of the trace on the screen, the voltage of the signal being measured is calculated as follows:

voltage when a ×1 probe or lead wire is connected directly

Voltage (V) = Value (V/ cm) indicated at VOLTS/ cm × shift (cm)

Voltage when using a ×10 probe

Voltage (V) = Value (V/ cm) indicated at VOLTS/ cm × shift (cm) × 10

Example

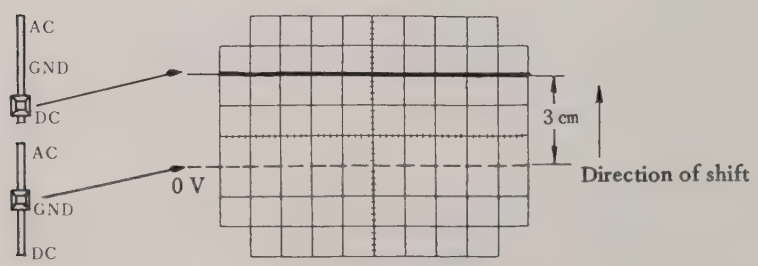
If the range indicated at the VOLTS/ cm is 2V/ cm , the voltage of the signal being measured is calculated as follows:

When a ×1 probe or lead wire is connected directly

2V/ cm × 3 cm = +6V

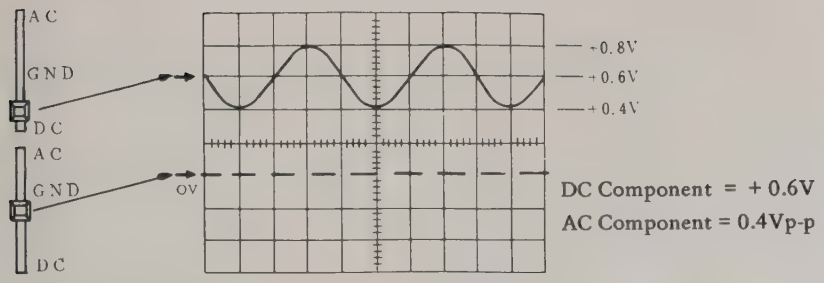
When using a ×10 probe

2V/ cm × 3 cm × 10 = +60V



6-3 DC + AC Peak Voltage

Make measurement using the "DC" and the "GND" as in the case of the measurement of DC voltage. If the range indicated at the VOLTS/ cm is 0.1V/ cm , the voltage of the signal being measured is obtained as shown below.



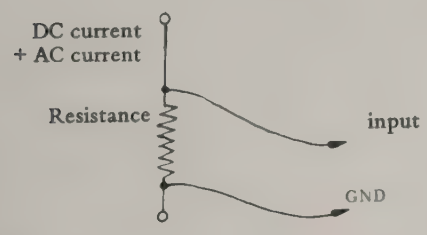
Note: When the DC component is much greater than the AC component, the waveform may be pushed off the screen making observation impossible. In this case, make measurements of the AC component and the DC component separately.

6-4 Current Measurement

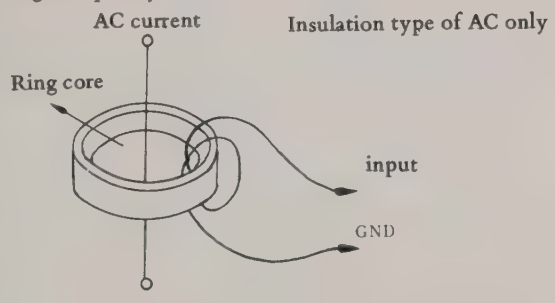
The voltage signal is the only phenomenon that can be observed by applying it to the oscilloscope directly. Accordingly, electric phenomena except for voltage, mechanical oscillation and all other phenomena must be converted into voltage and then applied to the input terminal.

When measuring current, insert known resistance into the circuit to be measured, observe a change is voltage across that resistance with an oscilloscope and convert it into current according to Ohm's law, that is E = IR, However, the resistance to be inserted must be within the range that causes no change in the operating condition of the circuit being measured.

Low frequency current measurement



High frequency current measurement



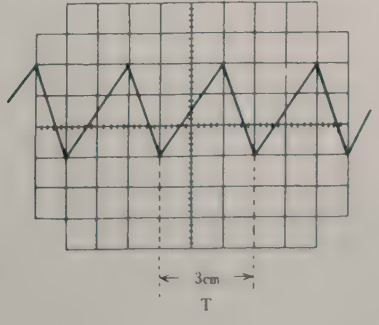
6-5 Time Interval Measurement

The time interval T is calculated as follows:

Time T (sec) = Value indicated at TIME/ cm × Distance on the screen × Reciprocal of magnification of the magnifier

The reciprocal of magnification of the magnifier is 1 when not magnified and 0.2 when magnified.

The time interval T in the left-hand figure is calculated as follows:



TIME/ cm = 0.5 (0.5mS/ cm)
When the magnifier is ×1,
T = 0.5 mS/ cm × 3 cm × 1 = 1.5msec
When the magnifier is × 5
T = 0.5mS/ cm × 3 cm × 0.2 = 0.3msec

6-6 Frequency Measurement

There are two methods using waveforms to measure frequency. One is to calculate the frequency from the time of 1 period, and the second method is to count the number of complete waveforms, or pulses, over the 10 cm horizontal width.

As regards to first method, the time of 1 period, T, is measured as given in the Section 6-5 above, and its reciprocal is the frequency F.

$$\text{Frequency F (Hz)} = \frac{1}{\text{T (seconds)}}$$

$$= \frac{1}{\text{Value indicated at TIME/ cm} \times \text{distance of 1 period on the screen} \times \text{reciprocal of magnification of the magnifier}}$$

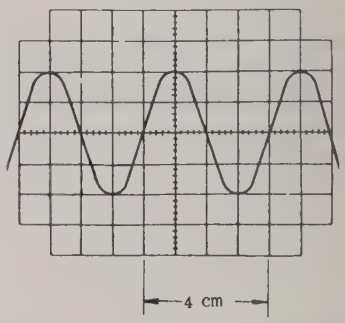
For example, in the right-hand figure,

TIME/ cm : 0.5mS/cm

Magnifier (MAG) : X1

Then, T = 0.5mS/ cm X 4 cm X 1 = 2msec

$$\text{Frequency F (Hz)} = \frac{1}{\text{T (sec)}} = \frac{1}{2 \times 10^{-3}} = 500\text{Hz}$$



As regards the second method, that is, counting the number of complete waveforms, or pulses, over the 10 cm horizontal width, the frequency is calculated as follows.

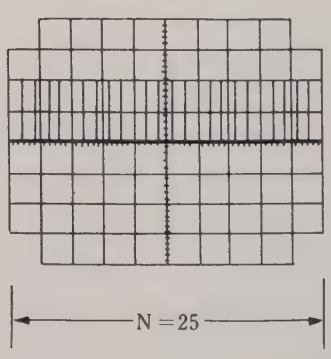
$$\text{Frequency F (Hz)} = \frac{\text{Number of pulses N}}{\text{Value indicated at TIME/ cm} \times \text{Reciprocal of magnification} \times 10\,\text{cm}}$$

Where, the reciprocal of magnification of the magnifier is 0.2 when magnified and 1 when not magnified.

For example, in the left-hand figure.

TIME/ cm : 1μs/ cm

Magnifier : X1



Then,

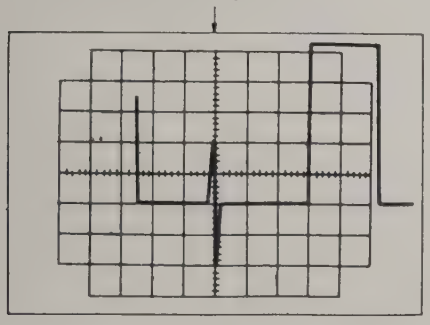
$$\text{Frequency F (Hz)} = \frac{25}{1\mu\,\text{sec/ cm} \times 10\,\text{cm} \times 1} = 2.5\text{MHz}$$

6-7 Rise Time of Pulse

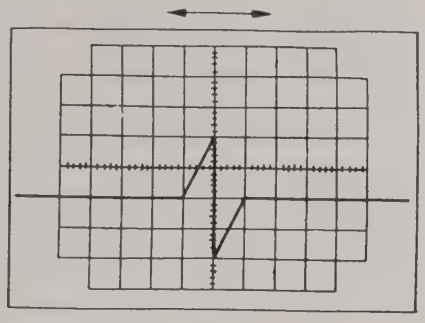
When measuring the rise time of a pulse the X 5 horizontal magnifier ⑳ is used.

Before measuring the rise time of a pulse, proper use of the magnifier will be described.

(1) Place the portion being observed on the center of the scale by means of the ⟷ knob.



(2) 5 times magnification to both sides.



As mentioned above, the magnifier is used for detailed observation of a portion of a waveform. This is especially convenient when the enlargement of a portion of a waveform, away from its sync. sweep starting point, is desired.

Rise time of pulse

(Procedure 1)

SLOPE ⑱ : – (Push)

MAG. ⑳ : X1 (Push)

Set TIME/ cm ㉑ so that the leading edge of the pulse is caught on the screen. Position the VARIABLE ㉒ (red knob) to the end of its clockwise rotation.

(Procedure 2)

Position the pulse so that the flat portion is placed on the screen at a height with no fractional values, e.g. just 5 cm . (This is for easy calculation of 10% upper and lower deduction, when required.)

(Procedure 3)

Place the leading edge of the pulse on the center line of the scale by means of the horizontal positioning knob.

(Procedure 4)

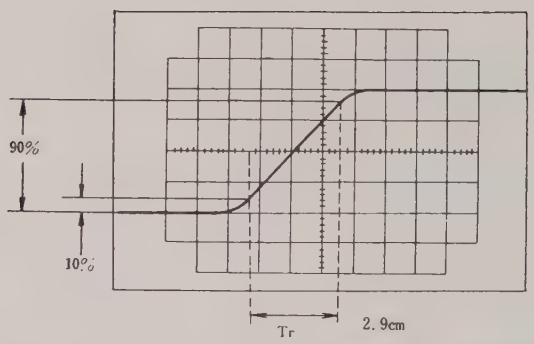
Make certain the MAGNIFIER is set at X 5 (PULL).

calculation of rise time

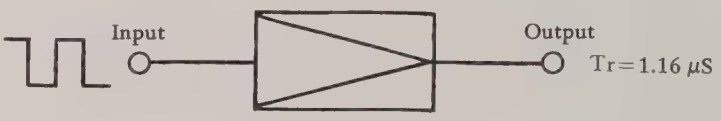
Tr = (TIME/ cm range) X (Horizontal distance on the screen, cm) X (Magnification rate, 1/ 5)

Example

Tr = 2μs/ cm X 2.9 cm X 1/ 5 = 1.16μs



On the basis of this rise time, Tr, the upper limit frequency of the amplifier, fc (−3dB), can be determined. For instance, on the assumption that the above measurement was performed with input pulses which were fast enough and that the value calculated represents the output waveform of the amplifier being tested, then the upper limit frequency, fc, of the amplifier can be found.



Amplifier being tested

$$Tr \leqslant \frac{\text{Tr of Output}}{10}$$

$$fc = \frac{0.35}{Tr} = \frac{0.35}{1.16 \times 10^{-6}} = 0.3 \times 10^{6} = 300\ \text{kHz}, \quad (-3\text{dB})$$

Units of time are enumerated below for reference:

Millisecond; ms = 10^{-3} Sec.
Microsecond; μs = 10^{-6} Sec.
Nanosecond; ns = 10^{-9} Sec.
Picosecond; ps = 10^{-12} Sec.

In the measurement of a comparatively fast pulse, the rise time of the LBO-507 must also be taken into consideration.

Rise time of the LBO-507 : Ta = 0.0175 μS

Rise time of the output of the amplifier being tested : Ti

Rise time observed on the screen : Tr

With this data, the ture rise time Ti is calculated:

$$Ti = \sqrt{Tr^2 - Ta^2}$$

6-8 (EXT H) Lissajous Patterns Measurements

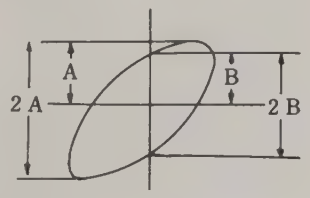
6-8-1 Phase difference measurement

The phase difference between two signals of the same frequency can also be measured using a Lissajous' figure by X-Y operation.

In this case, however, the frequency band of the X-axis (H IN) is 250 kHz, –3dB, thus causing a phase difference of 3° or less at 10 kHz between X and Y.

$$\sin\theta=\frac{B}{A}=\frac{2B}{2A}$$

$$\therefore \quad \theta=\sin^{-1}\frac{B}{A}$$



Place the Lissajous' figure on the center line of the scale both horizontally and vertically.

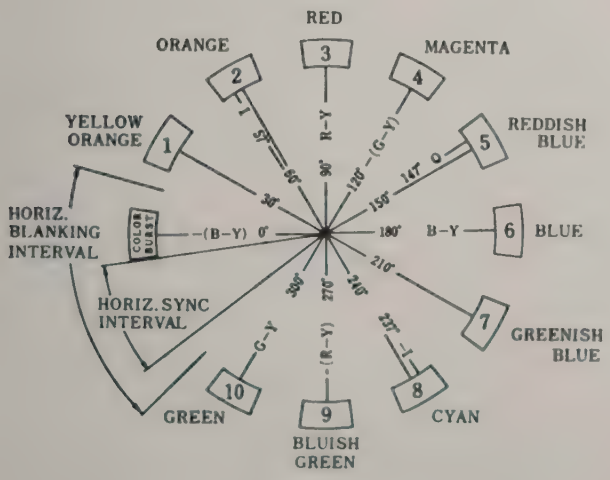
This X-Y operation can effectively be used to display the input and output characteristics of all kinds of electric circuits.

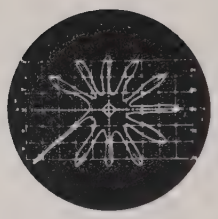
Also, to measure TV color hue, there is a method of displaying 10 colors of the gated rainbow pattern by X-Y operation (making use of a color bar pattern generator such as LEADER Model LCG-395A).

Phase relationships of the gated rainbow signal

The ten gated rainbow signals have the phase relationships as shown in the following figure. The color tint pattern (VECTOR) is obtained by applying the B-Y SIGNAL to the X-axis (H IN)and the R-Y SIGNAL to the Y-axis (V IN).

Feed the gated rainbow signals obtained from the color bar pattern generator to the color TV set.





Vector pattern

The floral pattern rotates as the TINT or HUE knob of the TV set is turned.

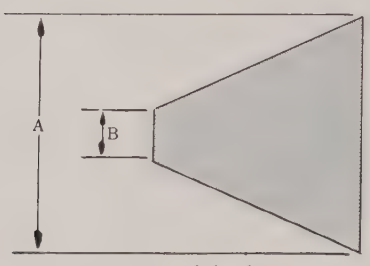
If the pattern spreads long instead of getting round, color saturation is responsible.

6-9 AM, SSB Transmission Modulated Wave Measurement

When observing modulation distortion or the like by providing synchronization to the envelope of amplitude modulated waves (SSB/DSB), apply voice waves to external synchronization and apply a modulation envelope of high frequency to V IN.

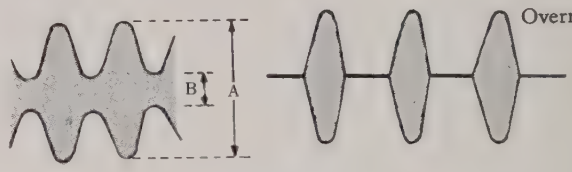
In the use of the trapezoid display, it is possible to confirm the linearity of modulation irrespective of modulated voice waves.

For trapezoid display, perform the aforementioned X-Y operation and apply voice waves to the X-axis (H IN) and high-frequency waves to the Y-axis (V IN).



Trapezoid display

AM (Amplitude) modulated wave



Degree of modulation $m = \frac{A-B}{A+B} \times 100\%$ (%)

6-10 Description of Applications by Transducers of Various Kinds

The oscilloscope is intended to observe electric oscillation, and it is also possible to observe all sorts of phenomena if they can be converted into electric signals by the use of transducers.

1) A change in tension is converted into an electric signal using a resistance wire or the like.
2) A change in pressure is observed by the use of a piezo-electric device.
3) Displacement is converted into a capacity change, and then it is further applied to an oscillator or the like and observed as a change in frequency.
4) A magnetic variation is observed using a magnetostriction device.
5) An optical displacement is observed using a photo transducer.
6) A temperature change is observed using a thermistor or thermocouple.

Besides all these mentioned above, many studies have been made on sensors recently, and it is suggested that reference be made to technical books.

6-11 Intensity modulation terminal (Z axis)

Intensity modulation can be obtained when a voltage of 0V ~ +5V is applied to this terminal in DC coupling under ordinary intensity condition.

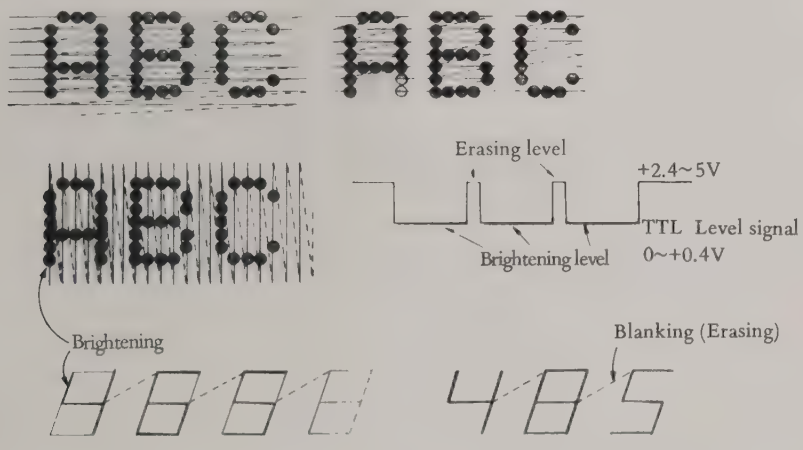
When a voltage of +2V ~ +5V (by a intensity control position) is applied, the trace line on the CRT will be erased.

When a voltage of 0V ~ +1V (by a intensity control position) is applied, the trace line will be intensified. That is, the instrument is used to erase a certain part of the trace line on the CRT or to intensify a certain part of the trace line in particular.

Application examples

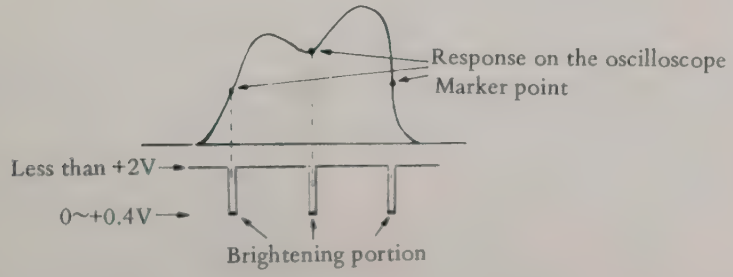
1. Making character display by computer output
   Since the intensity modulation terminal is in DC coupling, intensity modulation can be driven by a TTL level signal.

   Generally, there are two methods in making character display: random scanning method and raster scanning method. In either case, a needed portion can be made bright by giving a voltage of 0 ~ +0.4V to it. On the other hand, an unnecessary portion can be erased at a level of +2 ~ +5V.



2. Making marker display when measuring frequency response by means of a sweep generator
   When the frequency response of a measuring circuit are drawn on the CRT by means of a sweep generator, the instrument is capable of displaying the marker frequency point more precisely. When a precise display of the marker point is desired, apply a level signal of 0V ~ +0.4V to the brightness modulation terminal. When other level exceeds +2V at this time, the response trace may disappear.

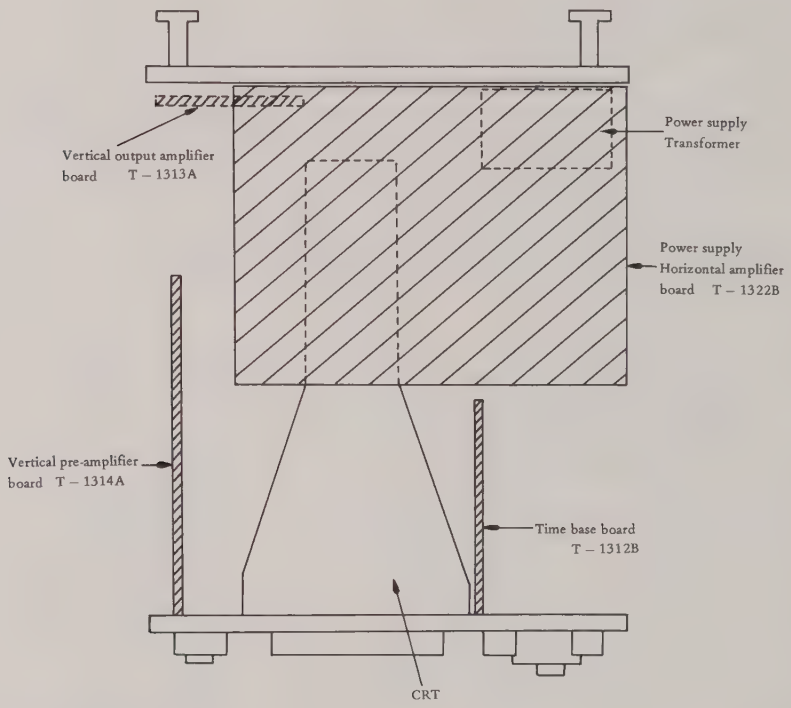
   Care, therefore, should be used not to exceed +2V in amplitude of the signal to be applied.



7. CALIBRATION AND MAINTENANCE

Every Unit goes out from factory with sever performance checks and interval adjustments, but if something wrong with the Unit found precautions should be taken with regard to the followings.

1. Pull out the plug of power supply before opening the case
2. Wait until condensers are completely discharged after pulling out the plug, as approximately 2 kV Voltage is working near the C.R.T. and high Voltage Circuits for several minutes.
   If right instruments for calibration are not available, refer all services to LEADER SERVICE DEPARTMENT. Adjusting trimmers are shown in letters and symbols on the printed board.


Vertical output amplifier board T – 1313A
Power supply Transformer
Power supply Horizontal amplifier board T – 1322B
Vertical pre-amplifier board T – 1314A
Time base board T – 1312B
CRT

Primal Parts Circuit Diagram

7-1 ⊘ ROTATION (Trace Slope)

Adjust the ⊘ ROTATION (beam rotation) knob on the front panel when slight tilting of the traces is caused by the effect of the external magnetic fields. Make certain that tilting of the traces is not caused by the effect of unusually strong external magnetic fields due to the position of the oscilloscope.

7-2 Preparations and checkings before Calibration

Set the power supply to the stipulated value. Please start calibration after calibration switch has been on for over 20 minutes.

Check each voltage at each test point before calibration. Each voltage allowances are as follows:
(All the below test points are installed on the power supply H AMP PC board.)

TP-1	–13.5 ~ 16.5 V
TP-2	+13.5 ~ 16.5 V
TP-3	+180 ~ 220 V
TP-4	+280 ~ 350 V

7-3 Adjust ⊘ DC BAL, if the veritcal position moves when the VARIABLE knobs ⑪ are turned. (⑫ → GND)
With the switch at AUTO, let a horizontal trace appear on the screen and turn the VARIABLE knob fully counterclockwise. Then, set the vertical position at this time to the center of the screen. (VOLTS/ cm → 20mV/cm or other constant range)
Next, turn the knob fully clockwise. If the position moves a large amount at this time, see it to the center of the scale by means of DC BAL.

DC Bal (VR 3202) is installed on Vertical Pre-Amp. P.C. Board T-1314

7-4 Attenuator Balancing

This adjustment is required when the spot position shifts with the VOLTS/ cm switch settings.

a. Set the AC-DC-GND switch at GND.

b. Set the VOLTS/ cm switch at .02 Position the trace on the center horizontal line.

c. Set the VOLTS/cm at .01.
If there is any shift in position, adjust STEP BAL. to return the trace to the .02 position.

Step Bal (VR 3201) is installed on Vertical pre-Amp P.C. Board T-1314.

7-5 Vertical Gain

Set the Vertical Gains as follows.
Set Vertical ATT at 0.1 V/ cm AC-DC-GND switch at DC, Variable to ❩ CAL'D, and if you connect Calibrater signal of 0.5 Vp-p with Vertical.
Input terminal, 5 cm of Amplitude will be obtained on the display.

GAIN (VR-3204) is installed on Vertical Pre-Amp P.C. Board T-1314

7-6 Width

a. Set TIME/ cm Range at 1 m S/ cm

b. Control ⊘ Width (VR 304) so that the Calibrated Square Wave and pulse connected with Vertical Input Terminal be displayed as long as 10 cm on the graticule. (Time Base PC Board T-1312)

7-7 Length Adjustment

Control ⊘ Length (VR-305) to adjust Horizontal Trace Line be 12 cm (Time Base P.C. Board T-1312)

7-8 Stability Adjustment

a. Feed a sinewave 1kHz signal to the INPUT.
Adjust the height to 4-5cm.

b. Set the LEVEL knob at AUTO. The sweep should synchronize when the white dot on the knob is around the midposition. If not, adjust ⊘ STABILITY (VR302).

c. Next, rotate VR302 in counterclockwise direction to the free-run condition and then in clockwise direction to the position where the sweep is stopped. The final setting of VR302 is at the midway of the two positions.

SCH. No.	Symbol No.	Description			LEADER Parts No.		Note
			RESISTORS				
1/7	R101	Carbon film ¼W	820KΩ	±5%	RD¼PNYJ	820KΩ	
1/7	R102	Carbon film ½W	10Ω	±10%	RD½PSZK	10Ω	
1/7	R103	Carbon film ¼W	1KΩ	±5%	RD¼PNYJ	1KΩ	
1/7	R104	Carbon film ¼W	6.8KΩ	±5%	RD¼PNYJ	6.8KΩ	
1/7	R105	Carbon film ¼W	1.8KΩ	±5%	RD¼PNYJ	1.8KΩ	
1/7	R106	Carbon film ¼W	2.7KΩ	±5%	RD¼PNYJ	2.7KΩ	
1/7	R107	Carbon film ¼W	1.8KΩ	±5%	RD¼PNYJ	1.8KΩ	
1/7	R108	Carbon film ½W	10Ω	±10%	RD½PSZK	10Ω	
1/7	R109	Carbon film ¼W	1KΩ	±5%	RD¼PNYJ	1KΩ	
1/7	R110	Carbon film ¼W	6.8KΩ	±5%	RD¼PNYJ	6.8KΩ	
1/7	R111	Carbon film ¼W	1.8KΩ	±5%	RD¼PNYJ	1.8KΩ	
1/7	R112	Carbon film ¼W	2.7KΩ	±5%	RD¼PNYJ	2.7KΩ	
1/7	R113	Carbon film ¼W	1.8KΩ	±5%	RD¼PNYJ	1.8KΩ	
1/7	R114	Carbon film ½W	330Ω	±10%	RD½PSZK	330Ω	
1/7	R115	Metal film 1W	270Ω	±10%	RSF1B	270ΩK	
1/7	R116	Carbon film ¼W	100KΩ	±5%	RD¼PNYJ	100KΩ	
1/7	R117	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ	10KΩ	
1/7	R118	Carbon film ¼W	12KΩ	±5%	RD¼PNYJ	12KΩ	
1/7	R119	Carbon film ¼W	1KΩ	±5%	RD¼PNYJ	1KΩ	
1/7	R120	Metal film ½W	10KΩ	±5%	SN14L2H	10KΩJ	
1/7	R121	Metal film ½W	150KΩ	±5%	SN14L2H	150KΩJ	
1/7	R122	Carbon film ¼W	2.2KΩ	±5%	RD¼PNYJ	2.2KΩ	
1/7	R123	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω	
1/7	R124	Metal film 3W	22KΩ	±10%	RSF3B	22KΩK	
1/7	R125	Carbon film ½W	270KΩ	±10%	RD½PSZK	270K	
1/7	R126	Carbon film ½W	270KΩ	±10%	RD½PSZK	270K	
1/7	R127	Metal film ½W	1MΩ	±5%	SN14L2H	1MΩJ	
1/7	R128	Carbon film ½W	150KΩ	±10%	RD½PSZK	150KΩ	
1/7	R129	Metal film ½W	1MΩ	±5%	SN14L2H	1MΩJ	
1/7	R130	Metal glaze ½W	5.6MΩ	±10%	RK½PK	5.6MΩ	
1/7	R131	Metal glaze ½W	5.6MΩ	±10%	RK½PK	5.6MΩ	
1/7	R132	Carbon film ½W	4.7MΩ	±10%	RD½PSZK	4.7MΩ	
1/7	R133	Carbon film ½W	4.7MΩ	±10%	RD½PSZK	4.7MΩ	
1/7	R134	Metal glaze ½W	2.7MΩ	±10%	RK½PK	2.7MΩ	
1/7	R135	Carbon film ½W	680KΩ	±10%	RD½PSZK	680KΩ	
1/7	R136	Metal glaze ½W	1.5MΩ	±10%	RK½PK	1.5MΩ	
1/7	R137	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω	
1/7	R138	Carbon film ¼W	4.7Ω	±5%	RD¼PNYJ	4.7Ω	
2/7	R3201	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω	
2/7	R3202	Carbon film ¼W	1KΩ	±5%	RD¼PNYJ	1KΩ	
2/7	R3203	Carbon film ¼W	560KΩ	±5%	RD¼PNYJ	560KΩ	
2/7	R3204	Metal film ½W	1MΩ	±1%	SN14L2H	1MΩF	
2/7	R3205	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ	10KΩ	
2/7	R3206	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ	10KΩ	
2/7	R3207	Carbon film ¼W	1.2KΩ	±5%	RD¼PNYJ	1.2KΩ	
2/7	R3208	Carbon film ¼W	1.2KΩ	±5%	RD¼PNYJ	1.2KΩ	
2/7	R3209	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω	
2/7	R3210	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ	4.7KΩ	
2/7	R3211	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ	4.7KΩ	
2/7	R3212	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω	
2/7	R3213	Carbon film ¼W	82Ω	±5%	RD¼PNYJ	82Ω	
2/7	R3214	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ	10KΩ	
2/7	R3215	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ	10KΩ	

SCH. No.	Symbol No.	Description			LEADER Parts No.	Note
			RESISTORS			
2/7	R3216	Carbon film ¼W	220Ω	±5%	RD¼PNYJ 220Ω	
2/7	R3217	Carbon film ¼W	220Ω	±5%	RD¼PNYJ 220Ω	
2/7	R3218	Carbon film ¼W	180Ω	±5%	RD¼PNYJ 180Ω	
2/7	R3219	Carbon film ¼W	5.6KΩ	±5%	RD¼PNYJ 5.6KΩ	
2/7	R3220	Carbon film ¼W	5.6KΩ	±5%	RD¼PNYJ 5.6KΩ	
2/7	R3221	Carbon film ¼W	220Ω	±5%	RD¼PNYJ 220Ω	
2/7	R3222	Carbon film ¼W	2.2KΩ	±5%	RD¼PNYJ 2.2KΩ	
2/7	R3223	Carbon film ¼W	2.2KΩ	±5%	RD¼PNYJ 2.2KΩ	
2/7	R3224	Carbon film ¼W	100Ω	±5%	RD¼PNYJ 100Ω	
2/7	R3225	Metal film ½W	124Ω	±0.5%	SN14L2E 124ΩD	
2/7	R3226	Carbon film ¼W	270Ω	±5%	RD¼PNYJ 270Ω	
2/7	R3227	Metal film ½W	277Ω	±0.5%	SN14L2E 277ΩD	
2/7	R3228	Carbon film ¼W	47Ω	±5%	RD¼PNYJ 47Ω	
2/7	R3229	Metal film ½W	759Ω	±0.5%	SN14L2E 759ΩD	
2/7	R3230	Carbon film ¼W	82Ω	±5%	RD¼PNYJ 82Ω	
2/7	R3231	Carbon film ¼W	68Ω	±5%	RD¼PNYJ 68Ω	
2/7	R3232	Carbon film ¼W	68Ω	±5%	RD¼PNYJ 68Ω	
2/7	R3233	Carbon film ¼W	100Ω	±5%	RD¼PNYJ 100Ω	
2/7	R3234	Carbon film ¼W	15KΩ	±5%	RD¼PNYJ 15KΩ	
2/7	R3235	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ 4.7KΩ	
2/7	R3236	Carbon film ¼W	180Ω	±5%	RD¼PNYJ 180Ω	
2/7	R3237	Carbon film ¼W	1.2KΩ	±5%	RD¼PNYJ 1.2KΩ	
2/7	R3238	Carbon film ¼W	5.6KΩ	±5%	RD¼PNYJ 5.6KΩ	
2/7	R3239	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ 4.7KΩ	
2/7	R3240	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ 4.7KΩ	
2/7	R3241	Carbon film ¼W	220Ω	±5%	RD¼PNYJ 220Ω	
2/7	R3242	Carbon film ¼W	100KΩ	±5%	RD¼PNYJ 100KΩ	
2/7	R3243	Carbon film ¼W	3.9KΩ	±5%	RD¼PNYJ 3.9KΩ	
2/7	R3244	Carbon film ¼W	820Ω	±5%	RD¼PNYJ 820Ω	
2/7	R3245	Carbon film ¼W	3.3KΩ	±5%	RD¼PNYJ 3.3KΩ	
2/7	R3246	Carbon film ¼W	3.3KΩ	±5%	RD¼PNYJ 3.3KΩ	
2/7	R3247	Carbon film ¼W	3.9KΩ	±5%	RD¼PNYJ 3.9KΩ	
2/7	R3248	Carbon film ¼W	1.2KΩ	±5%	RD¼PNYJ 1.2KΩ	
2/7	R3249	Carbon film ¼W	3.3KΩ	±5%	RD¼PNYJ 3.3KΩ	
2/7	R3250	Carbon film ¼W	3.9KΩ	±5%	RD¼PNYJ 3.9KΩ	
2/7	R3251	Carbon film ¼W	3.3KΩ	±5%	RD¼PNYJ 3.3KΩ	
2/7	R3252	Carbon film ¼W	820Ω	±5%	RD¼PNYJ 820Ω	
2/7	R3253	Metal film ½W	900KΩ	±1%	SN14L2H 900KΩF	
2/7	R3254	Metal film ½W	111KΩ	±1%	SN14L2H 111KΩF	
2/7	R3255	Metal film ½W	990KΩ	±1%	SN14L2H 990KΩF	
2/7	R3256	Metal film ½W	10.1KΩ	±1%	SN14L2H 10.1KΩF	
2/7	R3257	Carbon film ¼W	180Ω	±5%	RD¼PNYJ 180Ω	
2/7	R3258	Metal film ½W	1MΩF	±1%	SN14L2H 1MΩF	
2/7	R3259	Metal film ½W	1KΩF	±1%	SN14L2H 1KΩF	
2/7	R3260	Carbon film ¼W	680Ω	±5%	RD¼PNYJ 680Ω	
2/7	R3261					
2/7	R3262	Carbon film ¼W	10Ω	±5%	RD¼PNYJ 10Ω	
2/7	R3263	Carbon film ¼W	10Ω	±5%	RD¼PNYJ 10Ω	
2/7	R3264	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ 10KΩ	
2/7	R3265	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ 10KΩ	

SCH. No.	Symbol No.	Description			LEADER Parts No.	
			RESISTORS			
2/7	R241	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω
2/7	R242	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω
2/7	R243	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω
2/7	R244	Carbon film ¼W	1KΩ	±5%	RD¼PNYJ	1KΩ
2/7	R245	Carbon film ½W	1.2KΩ	±10%	RD½PSZK	1.2KΩ
2/7	R246	Carbon film ½W	1.2KΩ	±10%	RD½PSZK	1.2KΩ
2/7	R247	Carbon film ¼W	22Ω	±5%	RD¼PNYJ	22Ω
2/7	R248	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω
2/7	R249	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω
2/7	R250	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω
2/7	R251	Metal film 7W	5.6KΩ	±10%	RSF7B	5.6KΩK
2/7	R252	Carbon film ½W	100KΩ	±10%	RD½PSZK	100KΩ
2/7	R253	Carbon film ½W	1MΩ	±10%	RD½PSZK	1MΩ
2/7	R254	Carbon film ½W	1MΩ	±10%	RD½PSZK	1MΩ
2/7	R255	Carbon film ½W	100KΩ	±10%	RD½PSZK	100KΩ
2/7	R256	Metal film 7W	5.6KΩ	±10%	RSF7B	5.6KΩK
6/7	R301	Carbon film ¼W	1KΩ	±5%	RD¼PNYJ	1KΩ
6/7	R302	Carbon film ¼W	560KΩ	±5%	RD¼PNYJ	560KΩ
6/7	R303	Carbon film ½W	1MΩ	±10%	RD½PSZK	1MΩ
6/7	R304	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ	4.7KΩ
6/7	R305	Carbon film ¼W	470Ω	±5%	RD¼PNYJ	470Ω
6/7	R306	Carbon film ¼W	6.8KΩ	±5%	RD¼PNYJ	6.8KΩ
6/7	R307	Carbon film ¼W	6.8KΩ	±5%	RD¼PNYJ	6.8KΩ
6/7	R308	Carbon film ¼W	220Ω	±5%	RD¼PNYJ	220Ω
6/7	R309	Carbon film ¼W	220Ω	±5%	RD¼PNYJ	220Ω
6/7	R310	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω
6/7	R311	Carbon film ¼W	5.6KΩ	±5%	RD¼PNYJ	5.6KΩ
6/7	R312	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω
6/7	R313	Carbon film ¼W	39KΩ	±5%	RD¼PNYJ	39KΩ
6/7	R314	Carbon film ¼W	39KΩ	±5%	RD¼PNYJ	39KΩ
6/7	R315	Carbon film ¼W	56KΩ	±5%	RD¼PNYJ	56KΩ
6/7	R316	Carbon film ¼W	56KΩ	±5%	RD¼PNYJ	56KΩ
6/7	R317	Carbon film ¼W	22KΩ	±5%	RD¼PNYJ	22KΩ
6/7	R318	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω
6/7	R319	Metal film ½W	3.6KΩ	±5%	SN14L2H	3.6KΩJ
6/7	R320	Carbon film ¼W	100KΩ	±5%	RD¼PNYJ	100KΩ
6/7	R321	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ	4.7KΩ
6/7	R322	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ	10KΩ
6/7	R323	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ	10KΩ
6/7	R324	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ	10KΩ
6/7	R325	Carbon film ¼W	2.2KΩ	±5%	RD¼PNYJ	2.2KΩ
6/7	R326	Carbon film ¼W	1.2KΩ	±5%	RD¼PNYJ	1.2KΩ
6/7	R327	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ	10KΩ
6/7	R328	Carbon film ¼W	330Ω	±5%	RD¼PNYJ	330Ω
6/7	R329	Carbon film ¼W	1.2KΩ	±5%	RD¼PNYJ	1.2KΩ
6/7	R330	Carbon film ¼W	1.2KΩ	±5%	RD¼PNYJ	1.2KΩ
6/7	R331	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω
6/7	R332	Carbon film ¼W	120Ω	±5%	RD¼PNYJ	120Ω
6/7	R333	Carbon film ¼W	120Ω	±5%	RD¼PNYJ	120Ω
6/7	R334	Carbon film ¼W	100Ω	±5%	RD¼PNYJ	100Ω
6/7	R335	Carbon film ¼W	1.8KΩ	±5%	RD¼PNYJ	1.8KΩ

SCH. No.	Symbol No.	Description			LEADER Parts No.	Note
			RESISTORS			
6/7	R336	Carbon film ¼W	100Ω	±5%	RD¼PNYJ 100Ω	
6/7	R337	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ 10KΩ	
6/7	R338	Carbon film ¼W	22KΩ	±5%	RD¼PNYJ 22KΩ	
6/7	R339	Carbon film ¼W	22KΩ	±5%	RD¼PNYJ 22KΩ	
6/7	R340	Carbon film ¼W	22KΩ	±5%	RD¼PNYJ 22KΩ	
6/7	R341	Carbon film ¼W	22KΩ	±5%	RD¼PNYJ 22KΩ	
6/7	R342	Carbon film ¼W	10Ω	±5%	RD¼PNYJ 10Ω	
6/7	R343	Carbon film ¼W	100Ω	±5%	RD¼PNYJ 100Ω	
6/7	R344	Carbon film ¼W	1.5KΩ	±5%	RD¼PNYJ 1.5KΩ	
6/7	R345	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ 4.7KΩ	
6/7	R346	Carbon film ¼W	470Ω	±5%	RD¼PNYJ 470Ω	
6/7	R347	Carbon film ¼W	47KΩ	±5%	RD¼PNYJ 47KΩ	
6/7	R348	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ 4.7KΩ	
6/7	R349	Carbon film ¼W	3.9KΩ	±5%	RD¼PNYJ 3.9KΩ	
6/7	R350	Carbon film ¼W	1MΩ	±5%	RD¼PNYJ 1MΩ	
6/7	R351	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ 10KΩ	
6/7	R352	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ 4.7KΩ	
6/7	R353	Carbon film ¼W	1MΩ	±5%	RD¼PNYJ 1MΩ	
6/7	R354	Carbon film ¼W	1KΩ	±5%	RD¼PNYJ 1KΩ	
6/7	R355	Carbon film ¼W	22KΩ	±5%	RD¼PNYJ 22KΩ	
6/7	R356	Carbon film ¼W	5.6KΩ	±5%	RD¼PNYJ 5.6KΩ	
6/7	R357	Carbon film ¼W	5.6KΩ	±5%	RD¼PNYJ 5.6KΩ	
6/7	R358	Carbon film ¼W	10Ω	±5%	RD¼PNYJ 10Ω	
6/7	R359	Carbon film ¼W	680Ω	±5%	RD¼PNYJ 680Ω	
6/7	R360	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ 4.7KΩ	
6/7	R361	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ 10KΩ	
6/7	R362	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ 4.7KΩ	
6/7	R363	Carbon film ¼W	3.9KΩ	±5%	RD¼PNYJ 3.9KΩ	
6/7	R364	Carbon film ¼W	47KΩ	±5%	RD¼PNYJ 47KΩ	
6/7	R365	Carbon film ¼W	1.5KΩ	±5%	RD¼PNYJ 1.5KΩ	
6/7	R366	Carbon film ¼W	5.6KΩ	±5%	RD¼PNYJ 5.6KΩ	
6/7	R367	Carbon film ¼W	1KΩ	±5%	RD¼PNYJ 1KΩ	
6/7	R368	Carbon film ¼W	100KΩ	±5%	RD¼PNYJ 100KΩ	
6/7	R369	Carbon film ¼W	47KΩ	±5%	RD¼PNYJ 47KΩ	
6/7	R370	Metal film 5W	33KΩ	±10%	RSF5B 33KΩK	
6/7	R371	Metal glaze ¼W	4.63MΩ	±1%	RK¼PS 4.63MΩF	
6/7	R372	Metal film ½W	1.15MΩ	±1%	SN14L2H 1.15MΩF	
6/7	R373	Metal film ½W	226KΩ	±1%	SN14L2H 226KΩF	
6/7	R374	Metal film ½W	45.3KΩ	±1%	SN14L2H 45.3KΩF	
6/7	R375	Metal film ½W	10.9KΩ	±1%	SN14L2H 10.9KΩF	
6/7	R376	Metal glaze ¼W	2.30MΩ	±1%	RK¼PS 2.30MΩF	
6/7	R377	Metal film ½W	453KΩ	±1%	SN14L2H 453KΩF	
6/7	R378	Metal film ½W	113KΩ	±1%	SN14L2H 113KΩF	
6/7	R379	Metal film ½W	22.4KΩ	±1%	SN14L2H 22.4KΩF	
6/7	R380	Carbon film ¼W	1MΩ	±5%	RD¼PNYJ 1MΩ	
6/7	R381	Carbon film ¼W	22KΩ	±5%	RD¼PNYJ 22KΩ	
6/7	R382	Carbon film ¼W	1KΩ	±5%	RD¼PNYJ 1KΩ	
6/7	R383	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ 4.7KΩ	
6/7	R384	Carbon film ¼W	100Ω	±5%	RD¼PNYJ 100Ω	
6/7	R385	Carbon film ¼W	47KΩ	±5%	RD¼PNYJ 47KΩ	
6/7	R386	Carbon film ¼W	22KΩ	±5%	RD¼PNYJ 22KΩ	
6/7	R387	Carbon film ¼W	390Ω	±5%	RD¼PNYJ 390Ω	
6/7	R388	Carbon film ¼W	1KΩ	±5%	RD¼PNYJ 1KΩ	
6/7	R389	Carbon film ¼W	56KΩ	±5%	RD¼PNYJ 56KΩ	

SCH. No.	Symbol No.	Description			LEADER Parts No.	Note
			RESISTORS			
6/7	R390	Carbon film ¼W	27KΩ	±5%	RD¼PNJY 27KΩ	
6/7	R391	Carbon film ¼W	100Ω	±5%	RD¼PNJY 100Ω	
6/7	R392	Carbon film ¼W	10KΩ	±5%	RD¼PNJY 10KΩ	
6/7	R393	Carbon film ¼W	10KΩ	±5%	RD¼PNJY 10KΩ	
6/7	R394	Carbon film ¼W	22KΩ	±5%	RD¼PNJY 22KΩ	
6/7	R395	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ 10KΩ	
6/7	R396	Carbon film ¼W	4.7KΩ	±5%	RD¼PNYJ 4.7KΩ	
7/7	R401	Carbon film ¼W	1MΩ	±5%	RD¼PNYJ 1MΩ	
7/7	R402	Carbon film ¼W	470Ω	±5%	RD¼PNYJ 470Ω	
7/7	R403	Carbon film ¼W	2.7KΩ	±5%	RD¼PNYJ 2.7KΩ	
7/7	R404	Carbon film ¼W	330Ω	±5%	RD¼PNYJ 330Ω	
7/7	R405	Carbon film ¼W	8.2KΩ	±5%	RD¼PNYJ 8.2KΩ	
7/7	R406	Carbon film ½W	390KΩ	±10%	RD½PSZK 390KΩ	
7/7	R407	Carbon film ¼W	27KΩ	±5%	RD¼PNYJ 27KΩ	
7/7	R408	Carbon film ¼W	100Ω	±5%	RD¼PNYJ 100Ω	
7/7	R409	Carbon film ¼W	8.2KΩ	±5%	RD¼PNYJ 8.2KΩ	
7/7	R410	Carbon film ¼W	100Ω	±5%	RD¼PNYJ 100Ω	
7/7	R411	Carbon film ½W	68KΩ	±10%	RD½PSZK 68KΩ	
7/7	R412	Carbon film ½W	68KΩ	±10%	RD½PSZK 68KΩ	
7/7	R413	Metal film 5W	22KΩ	±10%	RSF5B 22KΩK	
7/7	R414	Carbon film ½W	330KΩ	±10%	RD½PSZK 330KΩ	
7/7	R415	Carbon film ¼W	10KΩ	±5%	RD¼PNYJ 10KΩ	
7/7	R416	Carbon film ½W	390KΩ	±10%	RD½PSZK 390KΩ	
7/7	R417	Carbon film ¼W	100Ω	±5%	RD¼PNYJ 100Ω	
7/7	R418	Carbon film ¼W	8.2KΩ	±5%	RD¼PNYJ 8.2KΩ	
7/7	R419	Carbon film ¼W	100Ω	±5%	RD¼PNYJ 100Ω	
7/7	R420	Carbon film ½W	68KΩ	±10%	RD½PSZK 68KΩ	
7/7	R421	Carbon film ½W	68KΩ	±10%	RD½PSZK 68KΩ	
7/7	R422	Metal film 5W	22KΩ	±10%	RSF5B 22KΩK	
			VARIABLE RESISTORS			
1/7	VR101	Metal glaze ½W	10KΩ		CR19R 10KΩB	⊘ CAL
1/7	VR102	Metal glaze ½W	10KΩ		CR19R 10KΩB	⊘ OFF SET
1/7	VR103	Carbon film	1MΩ		V16L4PH2N15S-B 1MΩ	FOCUS
1/7	VR104	Carbon film	1MΩ		V16L4PH2N15S-B 1MΩ	INTEN
1/7	VR105	Metal glaze ½W	1MΩ		CR19R 1MΩB	⊘ INTEN
2/7	VR3201	Metal glaze ½W	3.3KΩ		CR19R 3.3KΩB	⊘ STEP ATT BAL
2/7	VR3202	Metal glaze ½W	100Ω		CR19R 100ΩB	⊘ DC BAL
2/7	VR3203	Carbon film	1KΩ		GM70A 1KΩA/1KΩA	VARIABLE
2/7	VR3204	Metal glaze ½W	4.7KΩ		CR19R 4.7KΩB	⊘ GAIN
2/7	VR3205	Carbon film	10KΩ		VM10A873A-10KΩB	↕
2/7	VR202	Metal glaze ½W	470Ω		CR29R 470ΩB	⊘ MF
6/7	VR301	Carbon film	5KΩ		VM13A639-UER22-15R-B 5KΩ	LEVEL PUSH NORM / PULL AUTO
6/7	VR302	Metal glaze ½W	3.3KΩ		CR19R 3.3KΩB	⊘ STABILITY
6/7	VR303	Carbon film	10KΩ		GM70A 10KΩB	VARIABLE Gang with VR308
6/7	VR304	Metal glaze ½W	22KΩ		CR19R 22KΩB	⊘ WIDTH
6/7	VR305	Metal glaze ½W	470Ω		CR19R 470ΩB	⊘ LENGTH
6/7	VR308	Carbon film	100KΩ		GM70A 100KΩB	H GAIN Gang with VR303

SCH. No.	Symbol No.	Description			LEADER Parts No.	Note
			VARIABLE RESISTORS			
7/7	VR401	Carbon film	20KΩ		VM13A639-UER22-15R-B20KΩ	X
7/7	VR402	Metal glaze ½W	470Ω		CR19R 470ΩB	⊘ MAG. CENTER
7/7	VR403	Metal glaze ½W	1KΩ		CR19R 1KΩB	⊘ MAG. GAIN
7/7	VR404	Metal glaze ½W	10KΩ		CR19R 10KΩB	⊘ BIAS
			CAPACITORS			
1/7	C101	Electrolytic 50V	1000μF		50T1000	
1/7	C102	Electrolytic 50V	22μF		50VB22	
1/7	C103	Plastic film 50V	0.1μF	±10%	CQ92MB1H104K	
1/7	C104	Ceramic 50V	0.01μF		RD204YM103Z50	
1/7	C105	Electrolytic 50V	1μF		50VB1	
1/7	C106	Ceramic 50V	0.05μF		RD204YM503Z50	
1/7	C107	Electrolytic 50V	1000μF		50T1000	
1/7	C108	Electrolytic 50V	22μF		50VB22	
1/7	C109	Plastic film 50V	0.1μF	±10%	CQ92MB1H104K	
1/7	C110	Ceramic 50V	0.01μF		RD204YM103Z50	
1/7	C111	Electrolytic 50V	1μF		50VB1	
1/7	C112	Ceramic 50V	0.05μF		RD204YM503Z50	
1/7	C113	Electrolytic 315V	47μF		315T47	
1/7	C114	Electrolytic 315V	47μF		315T47	
1/7	C115	Electrolytic 160V	47μF		160T47	
1/7	C116	Electrolytic 450V	22μF		450T22	
1/7	C117	Oil 1500V	0.5μF	±20%	K150DULC504M	
1/7	C118	Oil 1500V	0.5μF	±20%	K150DULC504M	
1/7	C119	Oil 1500V	0.5μF	±20%	K150DULC504M	
1/7	C120	Oil 1500V	0.5μF	±20%	K150DULC504M	
1/7	C121	Oil 1500V	0.5μF	±20%	K150DULC504M	
1/7	C122	Ceramic 2000V	0.001μF	±10%	DD6200YW1000PF2KV±10%	
1/7	C123	Ceramic 500V	0.01μF		CK63YZ103PY500	
1/7	C124	Ceramic 50V	0.05μF		RD204YM503Z50	
1/7	C125	Ceramic 50V	0.01μF		RD204YM103Z50	
2/7	C3201	Metal film 630V	0.1μF	±20%	MD22J104M	
2/7	C3202	Plastic film 50V	0.01μF	±10%	CQ92MB1H103K	
2/7	C3203	Metal film 630V	0.01μF	±20%	MD22J103M	
2/7	C3204	Ceramic 50V	0.01μF		RD204YM103Z50	
2/7	C3205	Ceramic 50V	0.01μF		RD204YM103Z50	
2/7	C3206	Ceramic 50V	0.05μF		RD204YM503Z50	
2/7	C3207	Mica 50V	270pF	±10%	VFM09ZC271K	
2/7	C3208	Ceramic 50V	0.01μF		RD204YM103Z50	
2/7	C3209	Ceramic 50V	0.01μF		RD204YM103Z50	
2/7	C3210	Ceramic 50V	0.05μF		RD204YM503Z50	
2/7	C3211	Ceramic 50V	0.05μF		RD204YM503Z50	
2/7	C3212	Ceramic 50V	0.05μF		RD204YM503Z50	
2/7	C3213	Ceramic 50V	0.01μF		RD204YM103Z50	
2/7	C3214	Ceramic 50V	0.01μF		RD204YM103Z50	
2/7	C3215	Mica 500V	22pF	±10%	FM05ZC220K5	
2/7	C3216	Mica 500V	22pF	±10%	FM05ZC220K5	
2/7	C3217	Mica 500V	100pF	±10%	FM09ZC101K	
2/7	C3218	Mica 500V	27pF	±10%	FM07ZC270K	
2/7	C3219	Mica 500V	3pF	±10%	FM05ZC030K	
2/7	C3220	Mica 500V	47pF	±10%	FM07ZC470K	

SCH. No.	Symbol No.	Description				LEADER Parts No.	Note
				CAPACITORS			
2/7	C3221	Mica	500V	18pF	±10%	FM05ZC180K-	
2/7	C3222						
2/7	C3223	Ceramic	50V	0.01μF		RD204YM103Z50	
2/7	C3224	Electrolytic	25V	10μF		25VB10	
2/7	C3225	Mica	500V	10pF	±10%	FM05ZC100K	
2/7	C3226	Mica	500V	18pF	±10%	FM05ZC180K	
2/7	C3227	Mica	500V	56pF	±10%	FM07ZC560K	
2/7	C3228	Plastic film	50V	680pF	±10%	CQ09SC1H681K	
2/7	C3229						
2/7	C3230	Plastic film	50V	6800pF	±10%	CQ92MB1H682K	
2/7	C3231						
2/7	C3232	Ceramic	50V	0.01μF		RD204YM103Z50	
2/7	C3233	Electrolytic	25V	10μF		25VB10	
2/7	C3234	Electrolytic	25V	10μF		25VB10	
2/7	C3235	Ceramic	50V	0.01μF		RD204YM103Z50	
2/7	C3236	Ceramic	50V	0.01μF		RD204YM103Z50	
2/7	C3237	Mica	500V	3pF	±10%	FM05ZC030K	
2/7	C219	Mica	500V	82pF		FM09ZC820K5	
2/7	C220	Ceramic	50V	0.01μF		RD204YM103Z50	
2/7	C221	Ceramic	50V	0.01μF		RD204YM103Z50	
2/7	C222	Ceramic	500V	0.01μF		CK63YZ103PY500	
2/7	C223	Plastic film	630V	0.01μF		MD22J103M	
6/7	C301	Plastic film	50V	0.01μF	±10%	CQ92MB1H103K	
6/7	C302	Metal film	630V	0.01μF	±20%	MD22J103M	
6/7	C303	Electrolytic	50V	2.2μF		50VB2R2	
6/7	C304	Electrolytic	50V	2.2μF		50VB2R2	
6/7	C305	Electrolytic	50V	4.7μF		50VB4R7	
6/7	C306	Electrolytic	50V	4.7μF		50VB4R7	
6/7	C307	Electrolytic	50V	4.7μF		50VB4R7	
6/7	C308	Electrolytic	50V	1μF		50VB1	
6/7	C309	Mica	50V	330pF	±10%	VFM11ZC331K	
6/7	C310	Electrolytic	25V	10μF		25VB10	
6/7	C311	Ceramic	50V	0.05μF		RD204YM503Z50	
6/7	C312	Plastic film	50V	1000pF	±10%	CQ92MB1H102K	
6/7	C313	Mica	500V	10pF	±10%	FM05ZC100K5	
6/7	C314	Plastic film	50V	0.047μF	±10%	CQ92MB1H473K	
6/7	C315	Ceramic	50V	0.05μF		RD204YM503Z50	
6/7	C316	Mica	500V	56pF	±10%	FM05ZC560K5	
6/7	C317	Ceramic	50V	0.01μF		RD204YM103Z50	
6/7	C318	Mica	500V	1pF	±10%	FM05ZC010K5	
6/7	C319	Ceramic	50V	0.05μF		RD204YM503Z50	
6/7	C320	Mica	500V	68pF	±10%	FM07ZC680K5	
6/7	C321	Ceramic	50V	0.01μF		RD204YM103Z50	
6/7	C322	Mica	500V	33pF	±10%	FM07ZC330K5	
6/7	C323	Metal film	100V	0.47μF	±20%	1MFTD474M	
6/7	C324	Ceramic	50V	0.05μF		RD204YM503Z50	
6/7	C325	Mica	500V	22pF	±10%	FM05ZC220K5	
6/7	C326	Mica	500V	33pF	±10%	FM07ZC330K5	
6/7	C327	Plastic film	50V	0.022μF	±10%	CQ92MB1H223K	
6/7	C328	Metal film	100V	1μF	±2%	CF14TMM2A105G	
6/7	C329	Mica	50V	150pF	±10%	VFM11ZC151K	
6/7	C330	Plastic film	50V	1000pF	±2%	CQ08P2B102G	
6/7	C331	Mica	500V	15pF	±10%	FM05ZC150K5	
6/7	C332	Mica	500V	12pF	±10%	FM05ZC120K5	

SCH. No.	Symbol No.	Description			LEADER Parts No.	Note
		CAPACITORS				
6/7	C339	Ceramic 50V	0.01μF		RD204YM103Z50	
6/7	C340	Electrolytic 50V	4.7μF		50VB4R7	
6/7	C341	Electrolytic 50V	2.2μF		50VB2R2	
6/7	C342	Electrolytic 50V	2.2μF		50VB2R2	
7/7	C401	Ceramic 50V	0.01μF		RD204YM103Z50	
7/7	C402	Plastic film 50V	560pF	±10%	CQ09SC1H561K	
7/7	C403	Solid 500V	0.75pF	±10%	CGMSA-075K	
7/7	C404	Mica 500V	7pF	±10%	FM05ZC070K5	
7/7	C405					
7/7	C406	Mica 500V	22pF	±10%	FM05ZC220K5	
		VARIABLE CAPACITORS				
2/7	VC3201	Plastic film 500V	10pF		ECV-1TY10P14	
2/7	VC3202	Ceramic 500V	20pF		ECV-1ZW20X51	
2/7	VC3203	Plastic film 500V	10pF		ECV-1TY10P14	
2/7	VC3204	Ceramic 500V	20pF		ECV-1ZW20X51	
2/7	VC3205	Plastic film 500V	10pF		ECV-1TY10P14	
2/7	VC3206	Ceramic 500V	20pF		ECV-1ZW20X51	
2/7	VC201	Ceramic 500V	20pF		ECV-1ZW20X40	⊘ HF
7/7	VC401	Ceramic 500V	40pF		ECV-1ZW40X51	

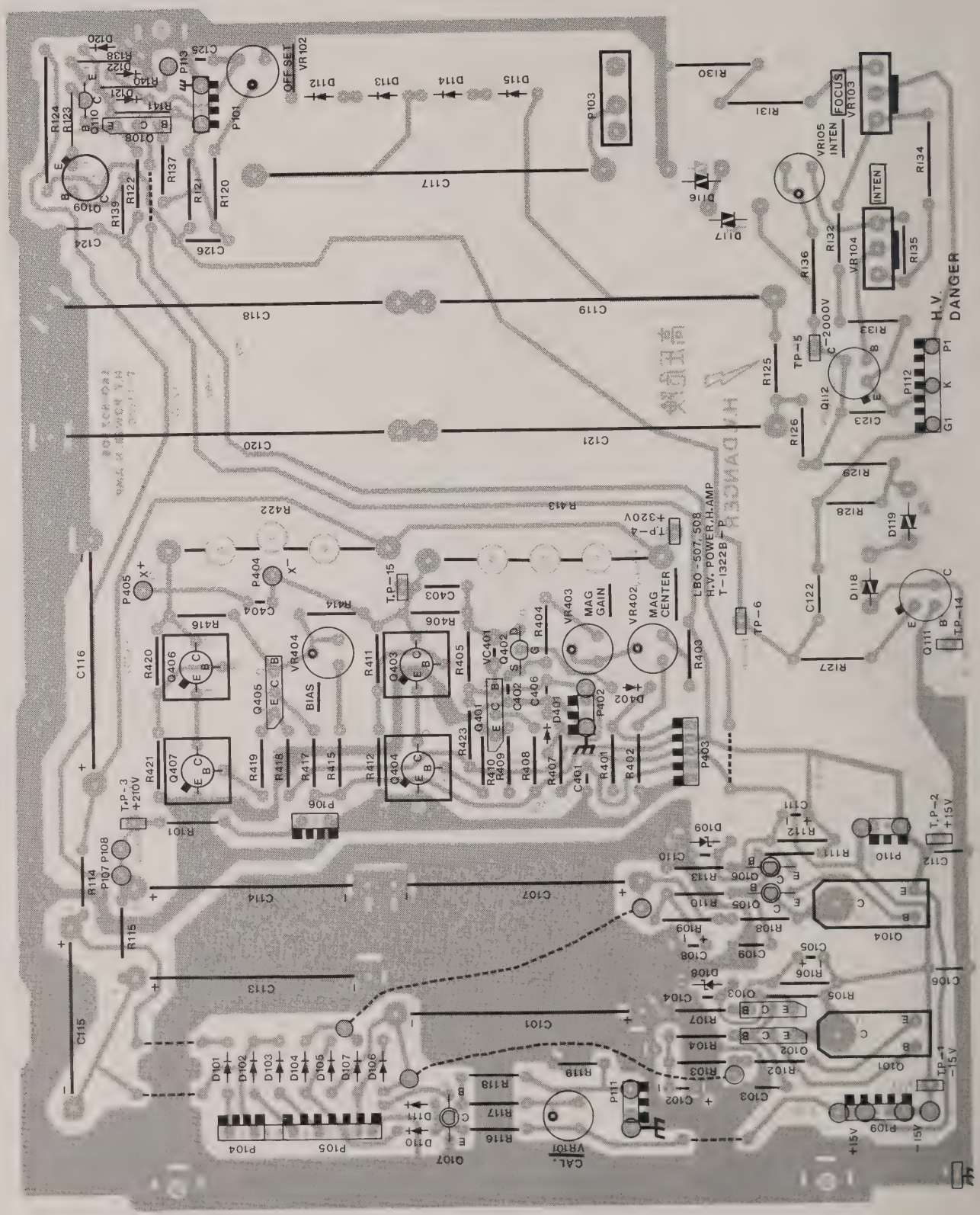
SCH. No.	Symbol No.	Description		LEADER Parts No.	Note
			TRANSISTORS		
1/7	Q101	NPN	VCEO=60V, Pc=35W	2SD315	
1/7	Q102	PNP	VCEO=50V, Pc=350mW	2SA678-6 or 7	
1/7	Q103	PNP	VCEO=50V, Pc=350mW	2SA678-6 or 7	
1/7	Q104	NPN	VCEO=60V, Pc=35W	2SD315	
1/7	Q105	NPN	VCEO=30V, Pc=200mW	2SC372-0	
1/7	Q106	NPN	VCEO=30V, Pc=200mW	2SC372-0	
1/7	Q107	NPN	VCEO=30V, Pc=200mW	2SC372-0	
1/7	Q108	PNP	VCEO=50V, Pc=350mW	2SA678-6 or 7	
1/7	Q109	NPN	VCBO=250V, Pc=2.5W(Tc=125°C)	2SC1012A	
1/7	Q110	NPN	VCEO=20V, Pc=200mW	2SC1215	
1/7	Q111	PNP	VCBO=300V, Pc=375mW	S-A92	
1/7	Q112	PNP	VCBO=300V, Pc=375mW	S-A92	
2/7	Q3201	NPN	VCEO=30V, Pc=200mW	2SC372-0 or Y	
2/7	Q3202	NPN	VCEO=30V, Pc=200mW	2SC372-0 or Y	
2/7	Q3203	J-FET	Vgss=40V, Pair	IMF-3958	
2/7	Q3204	NPN	VCEO=20V, Pc=300mW	MPQ918	
2/7	Q3205	NPN	VCEO=20V, Pc=200mW	2SC1215	
2/7	Q3206	NPN	VCEO=20V, Pc=200mW	2SC1215	
2/7	Q3207	PNP	VCEO=50V, Pc=350mW	2SA678-6 or 7	
2/7	Q3208	PNP	VCEO=50V, Pc=350mW	2SA678-6 or 7	
2/7	Q3209	NPN	VCEO=20V, Pc=200mW	2SC1215	
2/7	Q3210	NPN	VCEO=20V, Pc=200mW	2SC1215	
2/7	Q3211	NPN	VCEO=20V, Pc=200mW	2SC1215	
2/7	Q3212	NPN	VCEO=20V, Pc=200mW	2SC1215	
2/7	Q3213	NPN	VCEO=20V, Pc=200mW	2SC1215	
2/7	Q3214	NPN	VCEO=20V, Pc=200mW	2SC1215	
2/7	Q211	NPN	VCEO=30V, Pc=1W	2N3866	
2/7	Q212	NPN	VCEO=30V, Pc=1W	2N3866	
2/7	Q213	NPN	VCBO=250V, Pc=2.5W (Tc=125°C)	2SC1012A	
2/7	Q214	NPN	VCBO=250V, Pc=2.5W (Tc=125°C)	2SC1012A	
2/7	Q215	NPN	VCEO=150V, Pc=150mW	2SC780A	
6/7	Q301	NPN	VCEO=30V, Pc=200mW	2SC372-0	
6/7	Q302	NPN	VCEO=30V, Pc=200mW	2SC372-0	
6/7	Q303	J-FET	Vgss=50V	2SK30A-GR	
6/7	Q304	NPN	VCEO=30V, Pc=200mW	2SC372-0	
6/7	Q305	NPN	VCEO=30V, Pc=200mW	2SC372-0	
6/7	Q306	NPN	VCEO=30V, Pc=200mW	2SC372-0	
6/7	Q307	NPN	VCEO=30V, Pc=200mW	2SC372-0	
6/7	Q308	NPN	VCEO=30V, Pc=200mW	2SC372-0	
6/7	Q309	NPN	VCEO=20V, Pc=200mW	2SC1215	
6/7	Q310	NPN	VCEO=20V, Pc=200mW	2SC1215	
6/7	Q311	NPN	VCEO=20V, Pc=200mW	2SC1215	
6/7	Q312	NPN	VCEO=15V, Pc=200mW	2SC752	
6/7	Q313	NPN	VCEO=15V, Pc=200mW	2SC752	
6/7	Q314	PNP	VCEO=50V, Pc=350mW	2SA678-6 or 7	
6/7	Q315	NPN	VCEO=20V, Pc=200mW	2SC1215	

SCH. No.	Symbol No.	Description			LEADER Parts No.	Note
		TRANSISTORS				
6/7	Q316	NPN	VCEO=20V, Pc=200mW		2SC1215	
6/7	Q317	NPN	VCEO=20V, Pc=200mW		2SC1215	
6/7	Q318	NPN	VCEO=15V, Pc=200mW		2SC752	
6/7	Q319	PNP	VCEO=50V, Pc=350mW		2SA678-6 or 7	
6/7	Q320	PNP	VCEO=50V, Pc=350mW		2SA678-6 or 7	
6/7	Q321	NPN	VCEO=30V, Pc=200mW		2SC372-0	
6/7	Q322	PNP	VCEO=50V, Pc=350mW		2SA678-6 or 7	
6/7	Q323	J-FET	Vgss=50V		2SK30A-GR	
6/7	Q324	NPN	VCEO=30V, Pc=200mW		2SC372-0	
7/7	Q401	PNP	VCEO=50V, Pc=350mW		2SA678-6 or 7	
7/7	Q402	J-FET	Vgss=50V		2SK30A-GR	
7/7	Q403	NPN	VCBO=250V, Pc=2.5W(Tc=125°C)		2SC1012A	
7/7	Q404	NPN	VCBO=250V, Pc=2.5W(Tc=125°C)		2SC1012A	
7/7	Q405	PNP	VCEO=50V, Pc=350mW		2SA678-6 or 7	
7/7	Q406	NPN	VCBO=250V, Pc=2.5W(Tc=125°C)		2SC1012A	
7/7	Q407	NPN	VCBO=250V, Pc=2.5W(Tc=125°C)		2SC1012A	
		DIODES				
1/7	D101	Rect	1000V		1S1830	
1/7	D102	Rect	1000V		1S1830	
1/7	D103	Rect	1000V		1S1830	
1/7	D104	Rect	200V	1A	1DZ61	
1/7	D105	Rect	200V	1A	1DZ61	
1/7	D106	Rect	200V	1A	1DZ61	
1/7	D107	Rect	200V	1A	1DZ61	
1/7	D108	Zener	6V		RD6A(L)	
1/7	D109	Zener	6V		RD6A(L)	
1/7	D110	Det	35V		1S1588	
1/7	D111	Ge Det	35V		1N60	
1/7	D112	Rect	1500V		SIR150	
1/7	D113	Rect	1500V		SIR150	
1/7	D114	Rect	1500V		SIR150	
1/7	D115	Rect	1500V		SIR150	
1/7	D116	Ceramic Varistor	680V	10%	TNR681K015A	
1/7	D117	Ceramic Varistor	820V	10%	TNR821K015A	
1/7	D118	Ceramic Varistor	680V	10%	TNR681K015A	
1/7	D119	Ceramic Varistor	560V	10%	TNR561K015A	
2/7	D3201	Zener	5.1V		RD5.1EB	
2/7	D3202	Zener	5.1V		RD5.1EB	
2/7	D3203	Det	35V		1S1588	
3/7	D3204	Det	35V		1S1588	

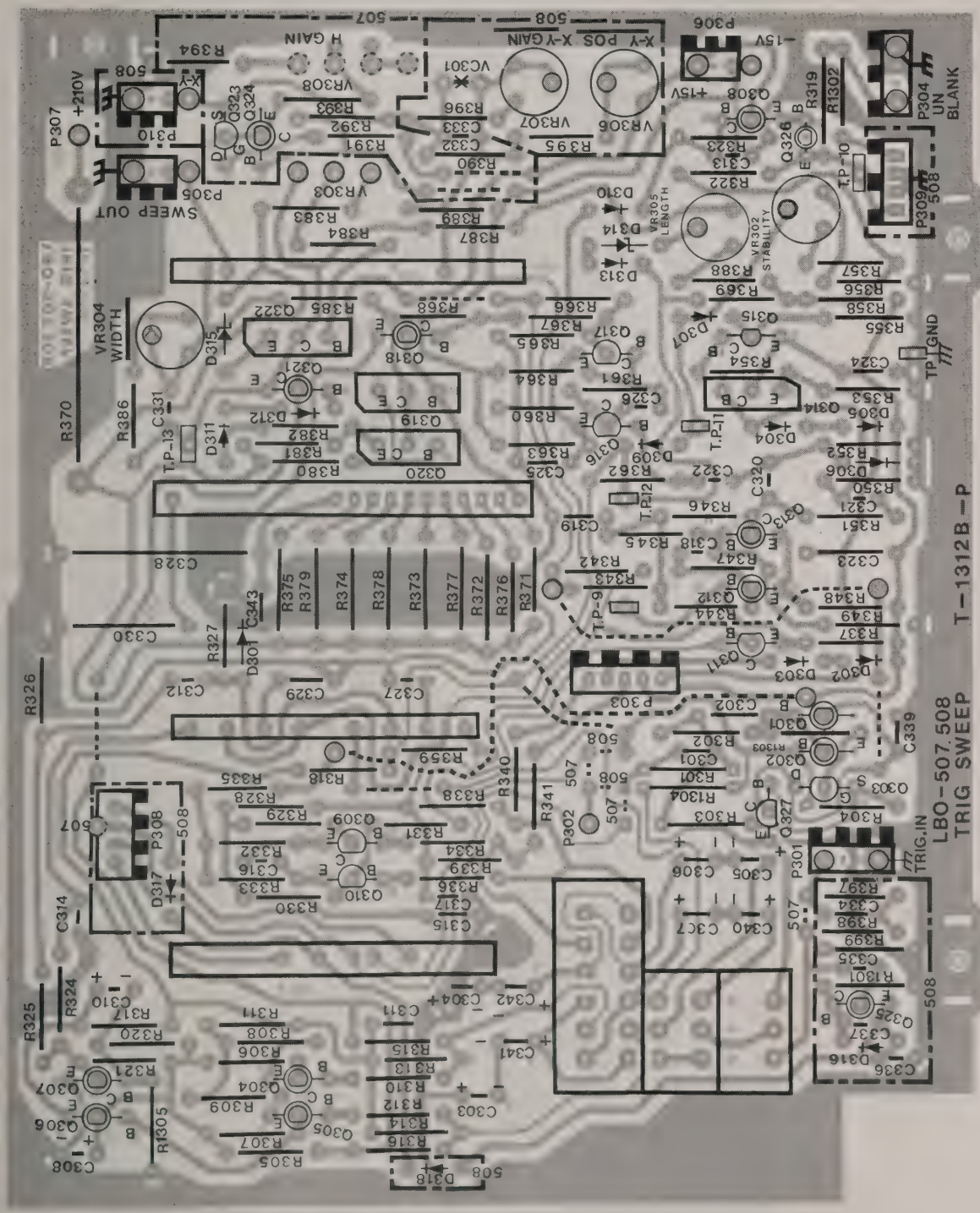
SCH. No.	Symbol No.	Description		LEADER Parts No.	Note
		DIODES			
6/7	D301	Ge Det	35V	1N60	
6/7	D302	Det	35V	1S1588	
6/7	D303	Det	35V	1S1588	
6/7	D304	Det	35V	1S1588	
6/7	D305	Det	35V	1S1588	
6/7	D306	Ge Det	35V	1N60	
6/7	D307	Det	35V	1S1588	
6/7	D308				
6/7	D309	Det	35V	1S1588	
6/7	D310	Det	35V	1S1588	
6/7	D311	Det	35V	1S1588	
6/7	D312	Det	35V	1S1588	
6/7	D313	Det	35V	1S1588	
6/7	D314	Zener	5V	RD5A(M)	
6/7	D315	Zener	5V	RD5A(M)	
7/7	D401	Det	35V	1S1588	
7/7	D402	Det	35V	1S1588	
		SWITCHES			
2/7	S3201	Slide		SL-83	
2/7	S3202	Rotary		Q-373	S21P/RV3-3-11
6/7	S301	Rotary		Q-369A	S32CP/RV4-7-19
6/7	S302	Push		SUB-3-1	
1/7	S101	Toggle		ST-1106D(or 8A1011)	
		TRANSFORMERS & COIL			
1/7	PT101			J-359	
		PRINTED CIRCUIT BOARDS			
2/7		V. PREAMP		T-1314A	
1/7,7/7		PWR, H.V., H.AMP		T-1322B	
6/7		TRIG. SWEEP		T-1312B	
5/7		V. FINAL		T-1313A	

SCH. No.	Symbol No.	Description	LEADER Parts No.	Note
		FUSE & LAMP		
1/7	F101	Holder	FH-003	
1/7	F101	Time lag 100~117V	F102, 5.2φ x 20mm, 0.5A (60°C)	
		Time lag 200~240V	F102, 5.2φ x 20mm 0.25A (60°C)	
1/7	PL101	Neon	BNB-2	
		TERMINALS		
2/7	J3201		BNC-BR2 (or BNC-080)	
6/7	J316		BNC-BR2 (or BNC-080)	
1/7	J120		E-307B	
1/7	J121		D-1376	
		CATHODE RAY TUBE		
1/7	V101		130BXB31	

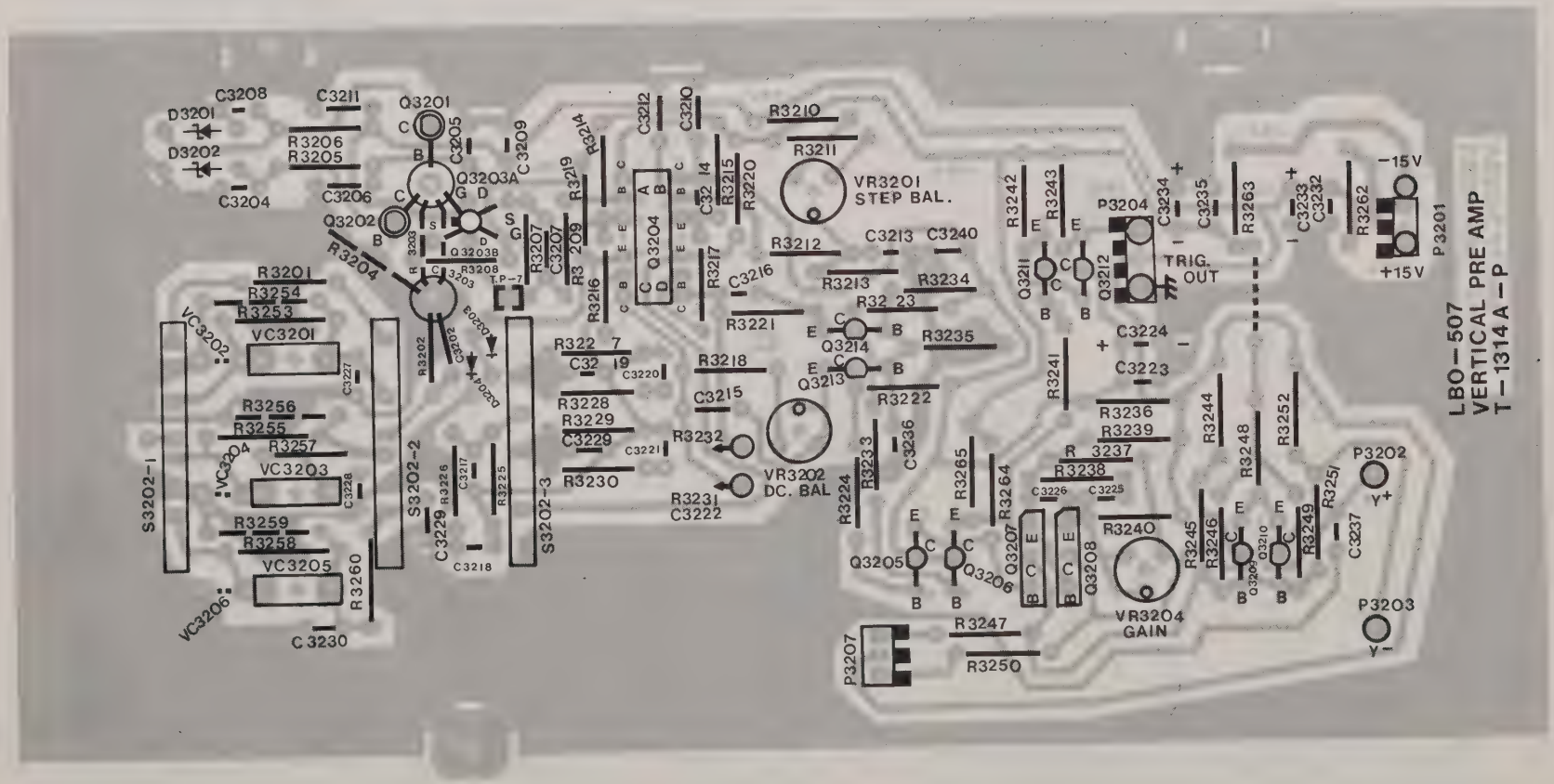
H. V. POWER H. AMP T-1322B



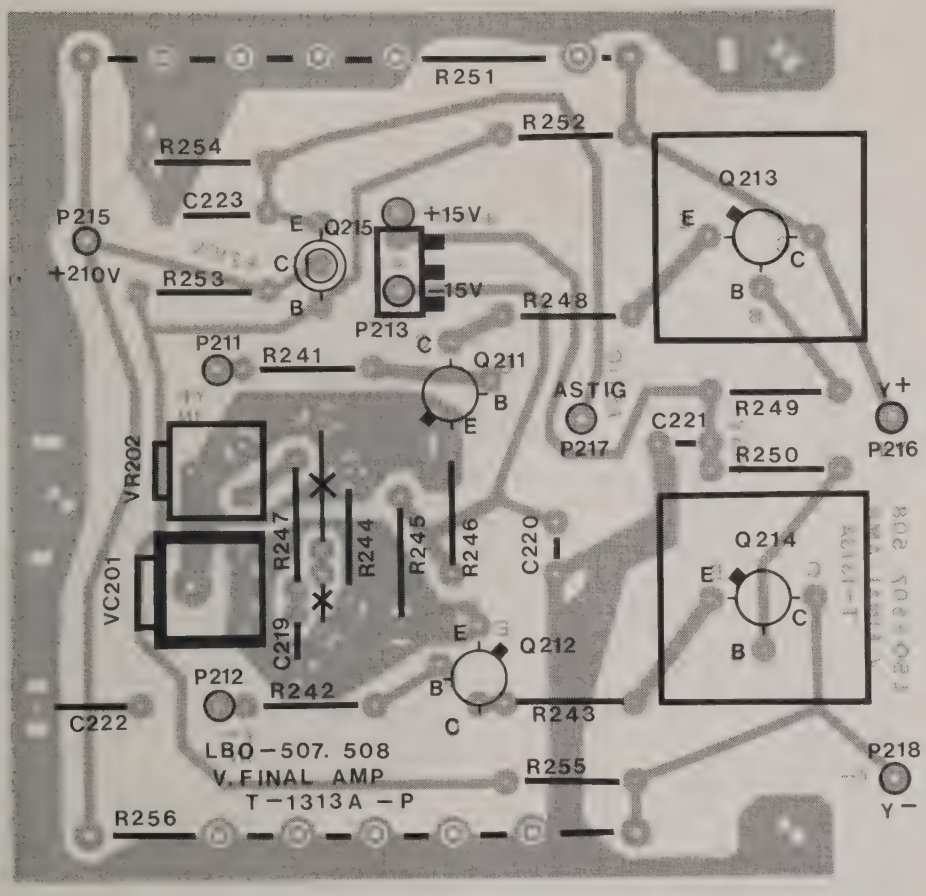
TRIG SWEEP T-1312B

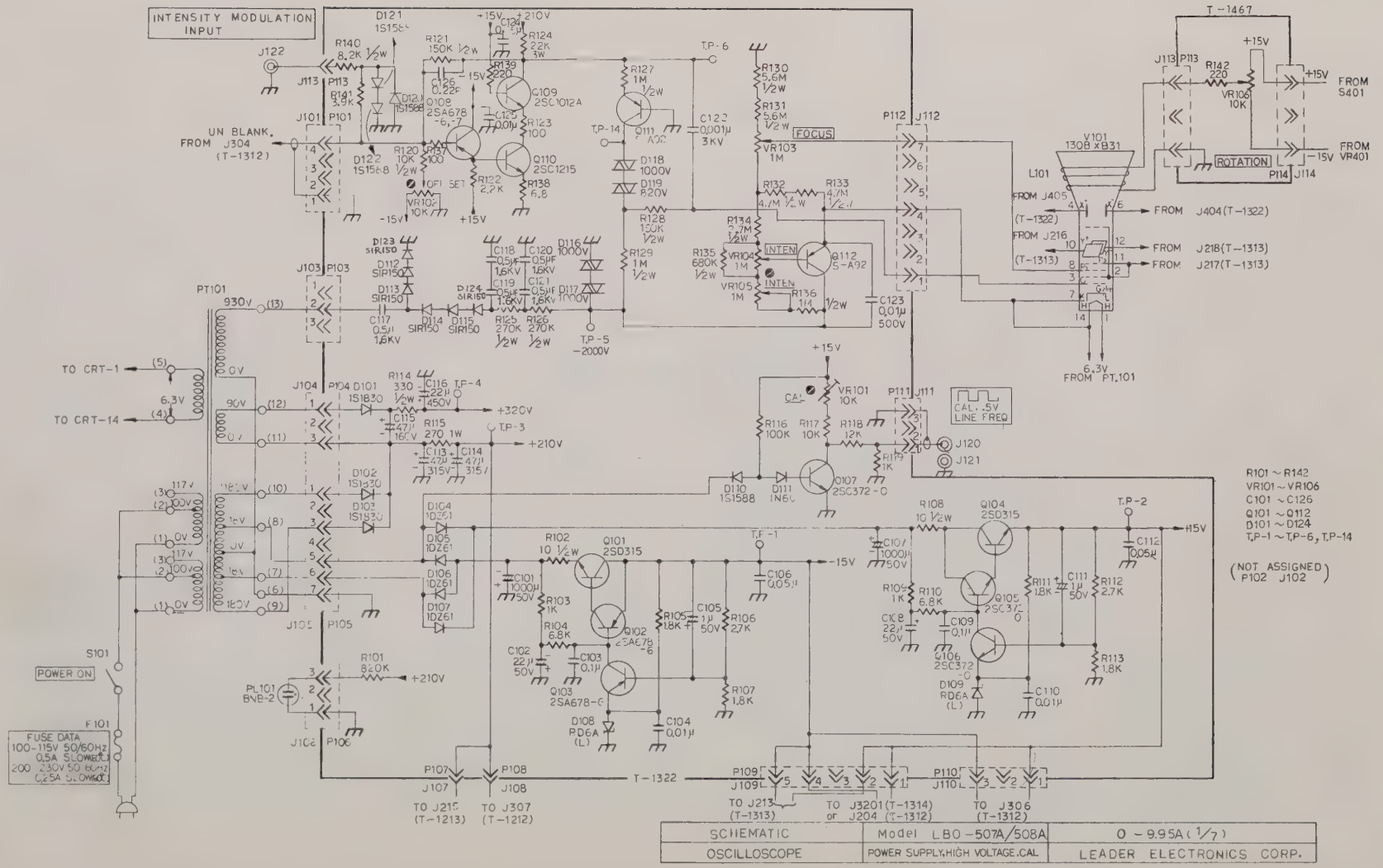


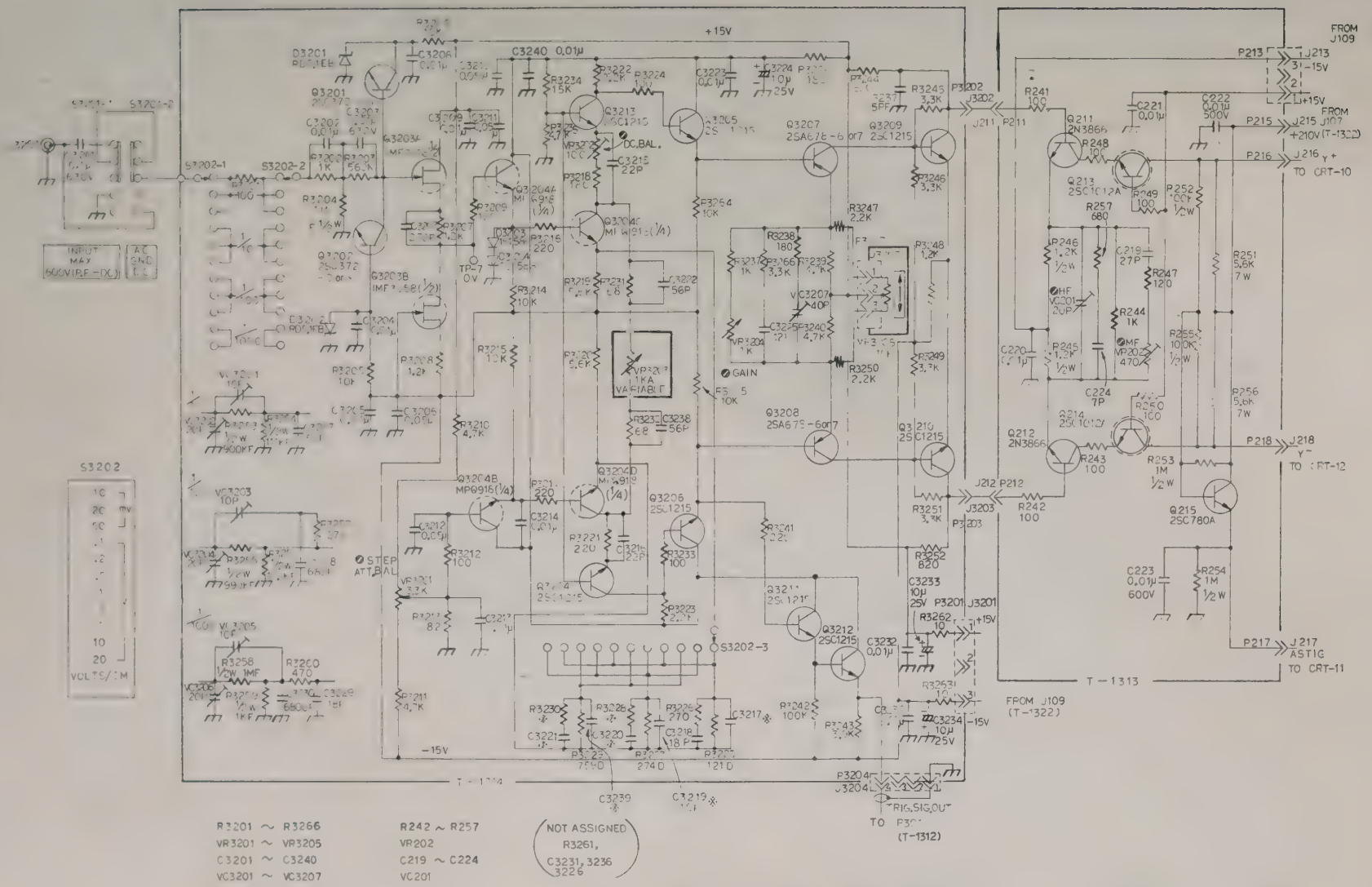
VERTICAL PREAMP T-1314A



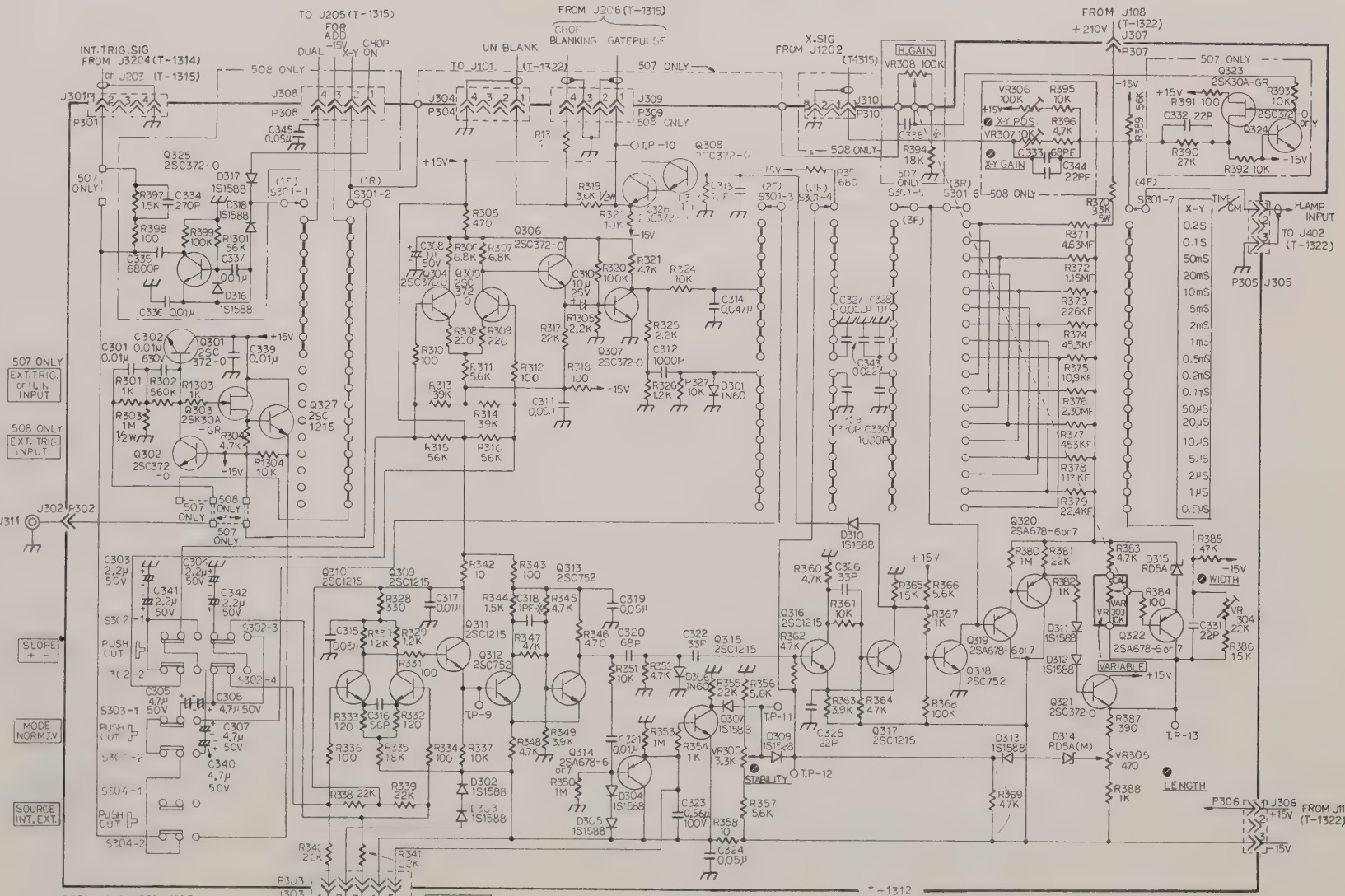
V. FINAL AMP T-1313A



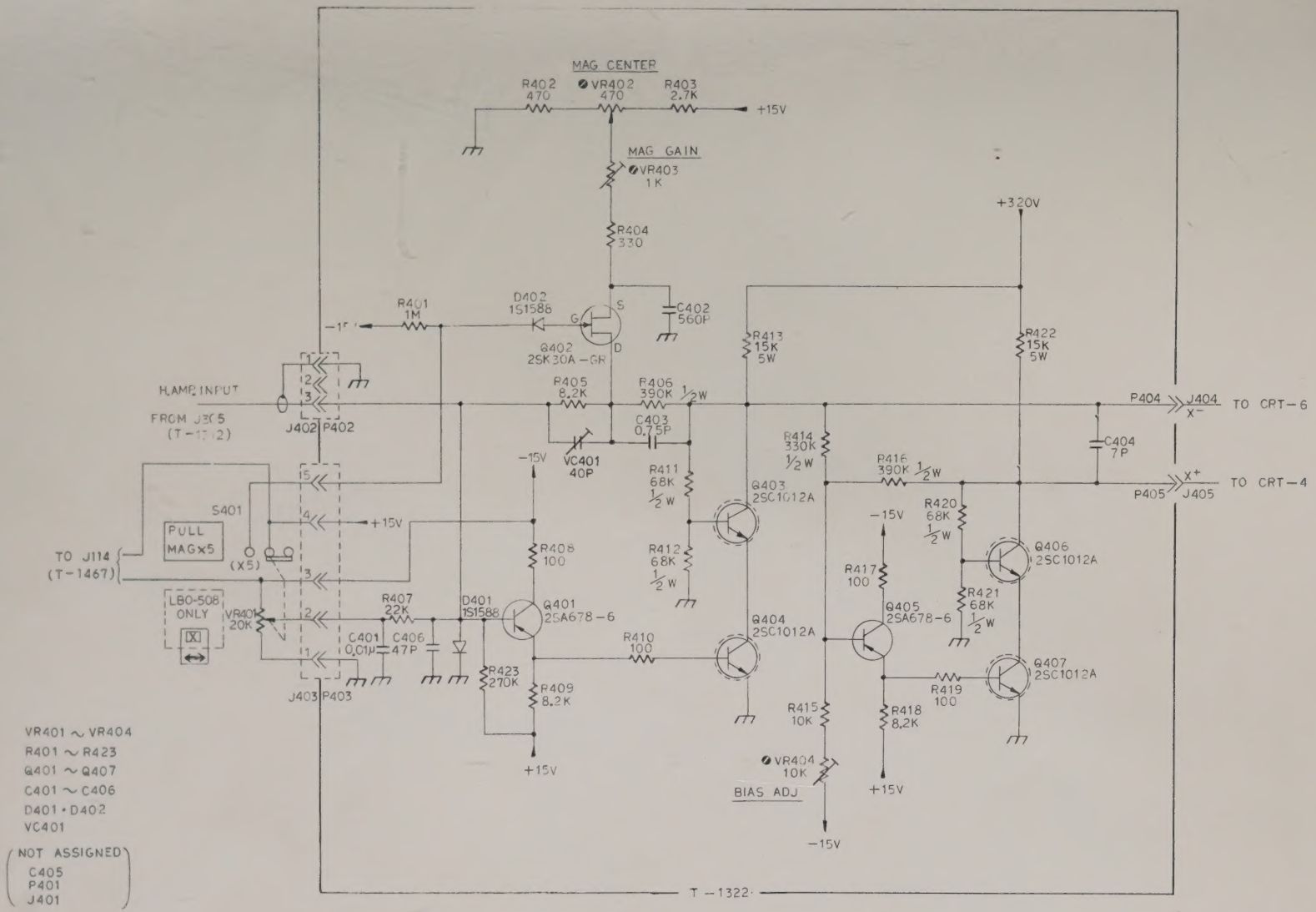

INTENSITY MODULATION INPUT
UN BLANK. FROM J304 (T-1312)
J122
J101
P101
J113
P113
R140 8.2K 1/2W
R141 3.9K
D121 1S1588
D122 1S1588
R120 10K 1/2W
R121 150K 1/2W
R122 2.2K
R123 100
R124 22K 3W
R127 1M 1/2W
R128 150K 1/2W
R129 1M 1/2W
R130 5.6M 1/2W
R131 5.6M 1/2W
R132 4.7M 1/2W
R133 4.7M 1/2W
R134 2.7M 1/2W
R135 680K 1/2W
R136 1M 1/2W
R137 100
R138 6.8
R139 220
C120 0.5pF
C121 0.5pF 1.6KV
C122 0.001µ 3KV
C123 0.01µ 500V
C125 0.01µ
C126 0.22µ
Q109 2SC1012A
Q110 2SC1215
Q111 2SA92
Q112 2SA92
Q107 2SC372-O
VR101 10K
VR102 10K
VR103 1M
VR104 1M
VR105 1M
OFF SET
FOCUS
INTEN
INTEN
CAL
CAL. .5V LINE FREQ
T.P-6
T.P-14
T.P-5 -2000V
T.P-4
T.P-3
T.P-2
T.P-1
+15V
+210V
-15V
+320V
+5V
D118 1000V
D119 R20V
D123 SIR150
D112 SIR150
D113 SIR150
D124 SIR150
D116 1000V
D117 1000V
D114 SIR150
D115 SIR150
C117 0.5µ 1.6KV
C118 0.5µF 1.6KV
C119 0.5µF 1.6KV
R125 270K 1/2W
R126 270K 1/2W
PT101
930V
TO CRT-1
TO CRT-14
6.3V
90V
80V
180V
117V
J103
P103
J104
P104
J105
P105
J106
P106
R114 330 1/2W
C116 22µ 450V
C115 47µ 160V
R115 270 1W
C113 47µ 315V
C114 47µ 315V
D101 1S1830
D102 1S1830
D103 1S1830
D104 1DZ61
D105 1DZ61
D106 1DZ61
D107 1DZ61
D108 PD6A (L)
D109 RD6A (L)
D110 1S1588
D111 IN60
R101 82.0K
R102 10 1/2W
R103 1K
R104 6.8K
R105 1K
R106 2.7K
R107 1.8K
R108 10 1/2W
R109 1K
R110 6.8K
R111 1.8K
R112 2.7K
R113 1.8K
R116 100K
R117 10K
R118 12K
R119 1K
C101 1000µ 50V
C102 22µ 50V
C103 0.1µ
C104 0.01µ
C105 1µ 50V
C106 0.05µ
C107 1000µ 50V
C108 22µ 50V
C109 0.1µ
C110 0.01µ
C111 1µ 50V
C112 0.05µ
Q101 2SD315
Q102 2SA678-6
Q103 2SA678-6
Q104 2SD315
Q105 2SC372-O
Q106 2SC372-O
S101
POWER ON
F101
FUSE DATA
100-115V 50/60Hz
0.5A SLOW
200-230V 50-60Hz
0.25A SLOW
PL101 BVB-2
J107
P107
J108
P108
T-1322
TO J215 (T-1213)
TO J307 (T-1212)
P109
J109
P110
J110
TO J213 (T-1313)
TO J3201 (T-1314) or J204 (T-1312)
TO J306 (T-1312)
T-1467
V101 130B XB31
L101
J113
P113
R142 220
VR106 10K
+15V
FROM S401
-15V
FROM VR401
ROTATION
P114
J114
FROM J405 (T-1322)
FROM J216 (T-1313)
FROM J404(T-1322)
FROM J218(T-1313)
FROM J217(T-1313)
6.3V FROM PT.101
J112
P112
J111
P111
J120
J121
R101 ~ R142
VR101 ~ VR106
C101 ~ C126
Q101 ~ Q112
D101 ~ D124
T.P-1 ~ T.P-6, T.P-14
(NOT ASSIGNED P102 J102)
SCHEMATIC
OSCILLOSCOPE
Model LBO-507A/508A
POWER SUPPLY, HIGH VOLTAGE.CAL
0 - 9.95A (1/7)
LEADER ELECTRONICS CORP.



SCHEMATIC	Model LBO-507A	0-995A (2/7)
OSCILLOSCOPE	VERTICAL AMP.	LEADER ELECTRONICS CORP.



SCHEMATIC	Model LBO-507A/508A	O-995A (6/7)
OSILLOSCOPE	TRIG. SWEEP CIRC.	LEADER ELECTRONICS CORP.



VR401 ~ VR404
R401 ~ R423
Q401 ~ Q407
C401 ~ C406
D401 • D402
VC401

(NOT ASSIGNED
C405
P401
J401)

SCHEMATIC	Model LBO-507A/508A	0-995A (7/7)
OSILLOSCOPE	4 HORIZONTAL AMP.	LEADER ELECTRONICS CORP.

LEADER TEST INSTRUMENTS

LEADER ELECTRONICS CORP.
2-6-33 TSUNASHIMA-HIGASHI, KOHOKU-KU,
YOKOHAMA, JAPAN.

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